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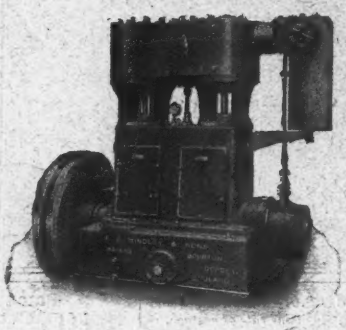

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THE
ELECTRICAL REVIEW.

VOL. LXXX. APRIL 20, 1917. No. 2,056.

ELECTRICAL REVIEW.

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WAYLEAVES.

FROM the moment that the linking-up of electrical undertakings came to be generally discussed after the reading of Mr. E. T. Williams's paper before the I.E.E. last spring, a discussion on the subject of wayleaves and consents became inevitable, and we desire to extend our congratulations to the Council on organising one last week, and on securing an introductory paper by such a well-known authority as Mr. C. Vernier, of the Newcastle Electric Supply Co. We may say at once that the paper is one of great practical importance, in that it contains an unchallengeable statement of the wayleave difficulties of the electricity supply authorities, and, in addition, it contains constructive proposals which would give effect to the scheme outlined in our columns on November 10th, 1916.

We should add that the discussion was worthy of the occasion, and the whole incident shows what great help the I.E.E. can give to the industry when it occasionally departs from purely technical subjects. No criticism of Mr. Vernier's proposals was forthcoming. This in itself was a striking testimony to the well-balanced judgment of the author, and a practical endorsement of the action of the Council in awarding, in advance, the Paris Premium to him. It was a graceful act on the part of our tactful President, Mr. Sparks, to make the announcement of the award after the discussion.

It is of no use disguising the fact that the discussion took place under a shadow. It is common knowledge that important evidence on the subject of wayleaves was given before the Electrical Trades Committee appointed by the Board of Trade, under the chairmanship of Sir Charles Parsons, and it is believed that the Committee reached some very definite conclusions on it. It would be interesting to know why the Committee has not yet officially reported to the President of the Board. Again, rumour has it that the delay is not in any way due to lack of unanimity among the members, and so we feel justified in joining in the demand that the report should be forthcoming as soon as possible. It is bound to be epoch-making when it appears, and we cannot help surmising that its non-publication is in some way connected with the formation of the further Committee under Mr. Huth Jackson.

It is obvious that the findings of the two Committees mentioned, and of the various other Board of Trade Committees, will require much legislation to give them effect, and there may be controversies over principles as well as details. For these reasons, we fear that Mr. Sparks was too optimistic in predicting the coming of compulsory wayleaves within

two years as part of a general Bill dealing with electrical matters. It may be, of course, that the present Government intends to give electricity priority over other domestic legislation during the war in view of the importance of saving coal.

Fortunately, there are no real differences of opinion among electricity supply authorities as to the need of compulsory wayleaves. The matter is exceedingly urgent in view of the large extensions which are being planned in various parts of the country in readiness for after-the-war conditions, and particularly in connection with big linking-up schemes, such as the one in Lancashire and Cheshire. After much reflection, we have come to the conclusion that the suggestion thrown out in the discussion by Mr. A. J. Stubbs—Assistant Engineer-in-Chief of the G.P.O.—should be followed up and forcibly urged on the Board of Trade, not as a permanent measure, but as a provisional one for helping the industry along until more extensive legislation can be undertaken. The request would be that the Board of Trade should make good the promise of necessary legislation in the well-known Saving of Coal and Linking-up Circular of May, 1916, by putting through, this Session, as a Government measure, a short Bill on similar lines to the Telegraph Construction Act of 1916. We think it should contain a provision that a final decision *must* be given within three months of negotiations for wayleaves or consents being commenced with the owner of the land or with the local authority.

The Board of Trade may possibly say that all urgent cases can be dealt with under the Defence of the Realm Acts, but electricity supply authorities know that landowners have long memories, and that it is preferable to proceed by less arbitrary methods. In any case, this procedure would not be available immediately after the war, when they expect to be really busy connecting up deferred customers. We desire, therefore, to urge full and immediate consideration of this matter by the I.E.E., the I.M.E.A., and the I.A.E.P.C. with a view to joint representations being made to the Board of Trade.

In conclusion, we trust that our readers will not grudge us the feeling of satisfaction that comes from having consistently called attention to the wayleave problem in electricity supply work, and the further feeling that a solution of it is rapidly coming into the realm of practical politics in the near future.

Support Hackney.

We publish elsewhere in this issue a spirited article by a central-station engineer (not in the London area), in which he draws attention to the failure of the municipal electricity supply undertakings of the kingdom to come to the support of the Hackney Borough Council in its fight with a powerful gas association. It will be remembered that at the annual conference of the I.M.E.A. last year, Mr. H. Faraday Proctor recommended the case to the members, and a resolution was passed pledging the Association to support the Council, with evidence and money; since then, the matter has been laid before the local electricity committees, with a view to the formation of a substantial guarantee fund, but so poor has been the response that, we believe, the total amount so far promised is less than £1,000. This is a very discreditable showing, and we fear that the local authorities have not appreciated the very great importance of the matter, not only to their undertakings, but also to their industrial consumers. Briefly put, the question at issue is whether the supply of electricity for lighting purposes at the rates charged for power is lawful, the contention of the gas association which has instituted the proceedings being that the practice constitutes a form of preferential tariff, in contravention of the Electric Lighting Acts. We cannot here enter into the merits of the question, which is *sub judice*, but we hardly need point out to readers conversant with the circumstances under which such terms are granted that a very strong case can be made out for this practice on technical grounds, that there is no element of unfairness in its working, and that power users will be put to serious and unnecessary expense if it is declared illegal, at a time when every assistance and encouragement ought to be afforded to them in the national interest. We should have thought, with our contributor, that in such a case the municipal authorities would have rallied to the support of the Council which is fighting their battle, and we must confess to a feeling of disappointment and regret that so few of them have realised the importance of the matter. It is not too late to make amends—and we may point out that in the highly probable event of victory for the Council, the guarantee fund will not be largely drawn upon. True economy is laudable; but to refrain from supporting so good a cause is not economy, but parsimony, and calls for the severest censure.

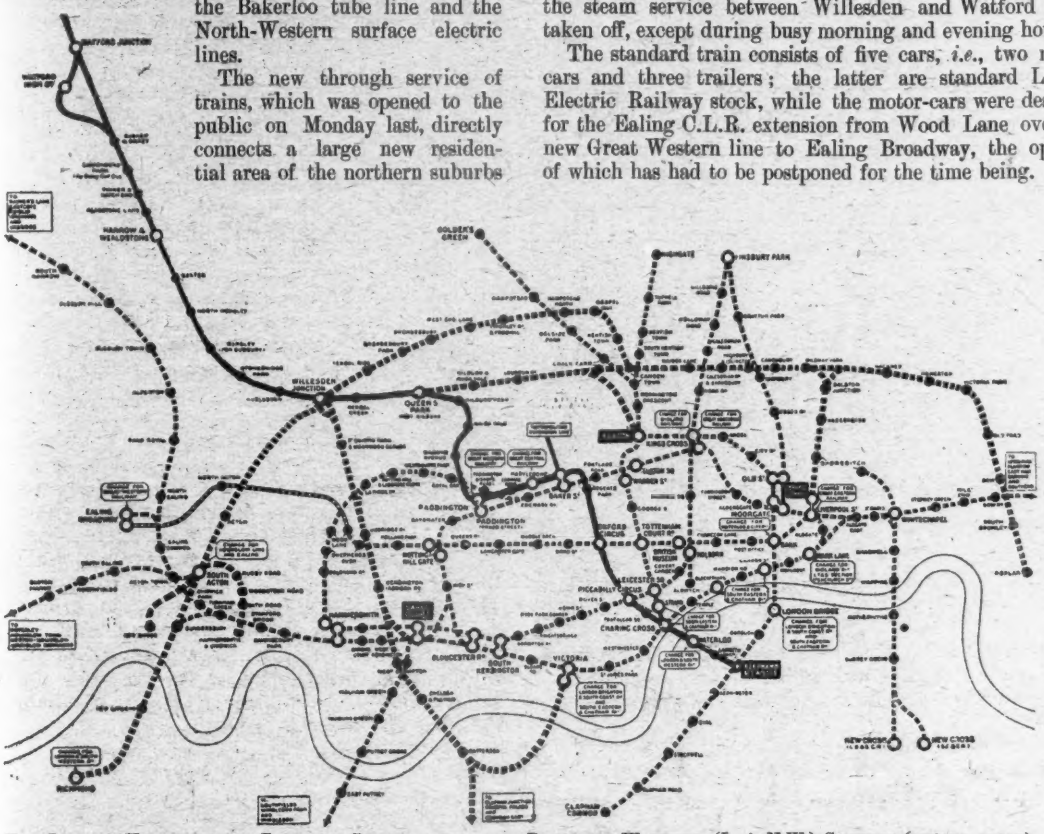
The E.T. Benevolent Institution.

Thanks to the abundance of opportunities for employment resulting from the war, the Electrical Trades Benevolent Institution experienced fewer calls upon its resources last year than in 1915, and we are glad to note that the subscriptions of members and annual subscribers increased; but the figures reveal the regrettable facts that the membership is still far below what it ought to be, and that the Institution has received but scanty support from the industry by way of donations since the Festival fell into abeyance. Now, as was pointed out at the annual meeting (reported elsewhere in this issue), the electrical trades have been exceedingly prosperous during the war, and it is only reasonable that this admirable Institution should share in their prosperity; it is in the sunny days that provision can and should be made for the rainy days of the future, and we commend to the directors of thriving electrical concerns the suggestion that it is their moral duty to support the Institution liberally, and to bring its merits to the notice of their employés. The capital fund, which is destined to provide for pensions, still falls short of £9,000—it should be raised to at least £20,000, and that quickly, for no one knows how soon the end of the war may throw a burden upon the Institution. We appeal to our readers to help in providing for the needs of their poorer brethren, both by contributing to the funds and by advertising the Institution as widely as possible—for there must be thousands who are not yet aware of its existence, objects, and advantages.

THE BAKERLOO—L. & N.W. WATFORD EXTENSION.

On Friday last we were privileged to take part in a trial run over the Bakerloo—Watford electric line, which, as no doubt many of our readers are aware, is a joint enterprise of the London Electric Railways and the London and North-Western Railway, the service having been rendered possible by the physical junction at Queen's Park between the Bakerloo tube line and the North-Western surface electric lines.

The new through service of trains, which was opened to the public on Monday last, directly connects a large new residential area of the northern suburbs with the extensive Underground system of London; incidentally it will give passengers using the L. & N.W.R. system a direct connection with the terminal stations at Paddington (G.W.R.), Marylebone (G.C.R.), Charing Cross (S.E. & C.R.), and Waterloo (L. & S.W.R.).



The London Underground Railway System, with the Bakerloo-Watford (L. & N.W.) Section (shown solid).

The extended service gives the Bakerloo trains a run of nearly 21 miles, with 30 stations on the route, two of which on the L.N.W. section are, however, temporarily closed; for the present the Bakerloo—Watford trains will also not stop at Maida Vale and Regent's Park, and during the rush hour period other Bakerloo stations will be omitted, with a view to giving a quicker run and relieving the trains of a certain amount of local traffic.

The full journey will take about one hour, and a quarter-hourly service will be provided, with 72 trains in each direction. The inauguration of the new service will enable the steam service between Willesden and Watford to be taken off, except during busy morning and evening hours.

The standard train consists of five cars, *i.e.*, two motor-cars and three trailers; the latter are standard London Electric Railway stock, while the motor-cars were designed for the Ealing C.L.R. extension from Wood Lane over the new Great Western line to Ealing Broadway, the opening of which has had to be postponed for the time being.

It will be seen that the motor-cars are provided with a hovered vestibule at the trailing end, and that middle doors ave been fitted. The control of the latter is similar to

Bakerloo Train on the Watford Route.

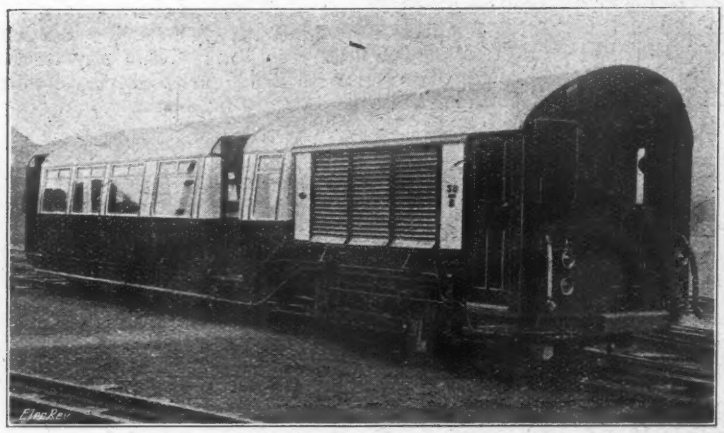
Interior of Motor Coach.

that in connection with the new stock for the Queen's Park extension.

This is the first tube stock to be run in passenger service on a main line, and provision has had to be made to enable passengers to get on or off at the stations on the L. & N.W

line which have platforms of the standard main line height. This has been done on the trailer cars by superimposing a raised platform on the existing gangways of these cars. It has been possible to do this without encroaching on available headroom, owing to the open character of these gangways. The closed vestibule has prevented any similar provision being made on the motor-cars.

The number of seats in the motor-cars is 32, and in the trailer cars, 52; the seats of the motor-cars are upholstered in red pegamoid, and in the trailer cars, in moquette, but some of the cars will enter service with the original rattan seats.



Motor Coach Employed in the Bakerloo—Watford Service.

The interior steel panels of the motor-cars are painted a light brown to tone in with the colour of the mouldings, &c., which are of teak or steel, painted to match; the lamp fittings and ends of cross seats are finished in oxidised bronze; other fittings are of aluminium alloy. The exterior colour of the cars is lake, with white upper panels and gold lettering.

With regard to ventilation, in addition to the ordinary drop lights, an air duct with perforations runs the whole length of the car, and is open to the air at the ends.

The cars are constructed of steel, with some wood interior finish.

The motor trucks are of the equaliser bar type, with helical springs; the framing is built up of mild-steel rolled sections.

The trailer trucks are built up of pressed steel sections, and are fitted with laminated side bearing springs.

The motor-cars were constructed by the Brush Co., and have a length overall of 47 ft. 9 in., while the weight of car completely equipped is—motor end, 21⅛ tons; trailer end, 9⅛ tons; total, 30¼ tons.

The total weight of a 5-car train (unloaded) is 110 tons.

The brake equipment is of Westinghouse type, with improved triple valves on the motor-cars and quick-acting triple valves on the trailers. The brake blocks are of unchilled cast-iron. The air compressor is of the B.T.H. C.P. 28A type.

All the cars are fitted with emergency electric lights, supplied from accumulators carried on the motor-car, and arranged to automatically switch on in the event of the main supply of current failing at any time.

Electric current at 600 volts D.C. will be supplied north of Queen's Park to Bakerloo trains from the L.N.W.R. power house at Willesden (see Elec. Rev., Aug. 11th, 1916).

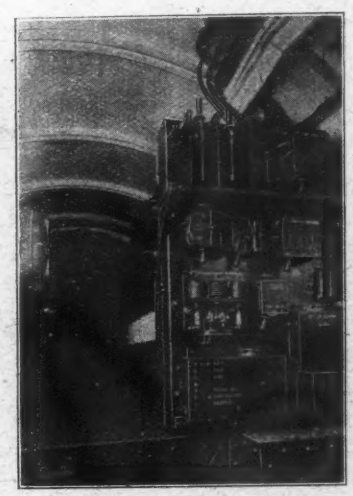
As the C.L.R. system employs an earth return, while the L.E.R. system employs an insulated return, it has been necessary to modify the equipment of the motor-cars accordingly.

For this purpose, two additional sets of shoe gear have been fitted on the motor-trucks, one on either side. On the trailer-truck of the motor-car there was insufficient clearance below the sole-bar of the body to fit positive shoes, so that these have had to be arranged on the truck of the adjacent L.E.R. trailer-car, and connection made to the motor-car by means of jumpers.

Other points in the conversion from earth to insulated return were the provision of negative switches and fuses to the main circuit and each of the auxiliary circuits. In doing this care was taken to reproduce the standard arrangement of London Electric Railway wiring, so that, electrically, the difference between the two types of stock should be confined to the control equipment.

The control equipment supplied by the B.T.H. Co. is of the relay automatic type. The normal method of operation with this system is to place the controller at once to the full-on position when starting a train. The contactors are then picked up in their correct sequence by the current limit relay, which operates as soon as the motor current has dropped to a predetermined value.

The relay consits of two shunt and one main coil. The latter carries current equal to that of one motor only. The actuating coils of the contactors are energised through one or other of the two shunt coils in such a manner that, if one is energised through one shunt coil, the next one to close will be energised in series with the other shunt coil. The two relay shunt coils act on two plungers controlled by gravity. Each plunger, when in its lower position, closes a disk switch in series with the other shunt coil; but when raised (due to its coil being energised) opens this switch. Thus, when one of the plungers is raised, the shunt coil, acting on the other, cannot be energised because of the break in the circuit produced by the above-mentioned switch, but although it is the control current that raises the plunger, so as to produce this break, it is the current passing through the main coil which maintains the break, and the plunger is not released until this current has dropped to the pre-determined value. Then the plunger falls and closes the switch which completes the circuit for the next contactor coil to be energised.



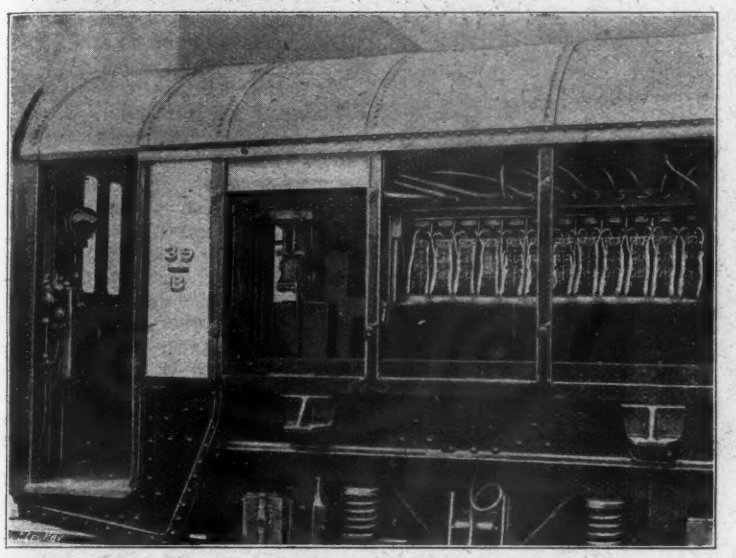
Main Switchboard, Contactors, &c., in Motor Coach.

Raised Gangways to Equalise Difference in Platform Levels.

The principle underlying the method of control adopted in connection with the current limit relay is that, after a contactor has been picked up, as described above, its coil is immediately transferred (by means of interlocks) to another wire. There are thus essentially two operating wires, the picking up wire and the retaining wire (although other

wires are introduced for forward and reverse, circuit-breaker setting, &c.

As there are no main bus lines down the train a potential relay is fitted on each motor-car, which drops all contactors on that car when the shoes lose current. This is necessary, because when no current passes through the main coil of the current limit relay it ceases to exercise its control over the rate of picking-up of contactors.



Switch Compartment, Motor Coach, with Side Panels Removed.

The controller has four forward points and two reverse (series only), of which Nos. 2 and 4 are running points, where all resistance is cut out.

A useful provision in the control is that if in the course of the automatic notching up the controller handle is brought back to the first or third notch, as the case may be, the automatic closing of contactors is stopped, but those already closed are kept up.

The working of the safety button on the controller handle differs from the L.E.R. standard in that the safety button can be released, except when the handle is at off position. If, however, the handle itself be let go, it flies back to off position, when current is immediately cut off and the brakes applied throughout the train.

Another safety device, which is now part of the standard L.E.R. equipment, is the control circuit governor. By interrupting the control circuits it prevents the train being driven forward unless the train pipe of the Westinghouse brake is charged with air and the tripcock is cut in.

Each motor-car is fitted with two G.E. 212 motors of 240 H.P., geared for a free running speed of 35-40 M.P.H.

LIGHTING ENERGY AT POWER RATES.

The Hackney Action.

[COMMUNICATED.]

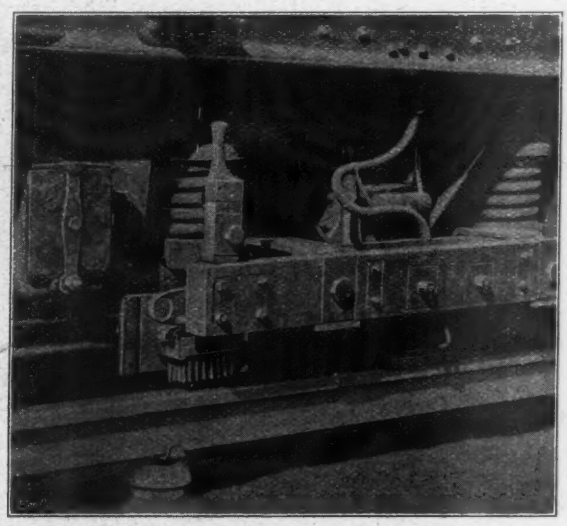
When the Gas Association decided to go for Hackney, we electrical optimists smiled, with the great big smile of the tiger when he sees his dinner walking the right way. As well as the gas men, we knew that all the pother was not for the benefit of Hackney, but that a verdict was wanted which would prevent factories from obtaining lighting energy at power rates. If the gas men win, our factories will require two sets of cables throughout, one for power and the other for lighting; a motor set up a hundred yards from the mains will require two sets of cables, one for the motor current and one for the lamp beside it. The silly change will require the expenditure of thousands of pounds for new wiring, money thrown away for nothing at all; and if it comes, it will hamper our trade in the coming struggle in a way that will make the Huns shout for joy.

We optimists thought of all that, and we watched for the instant response from the whole electrical industry. We knew that Hackney had nothing to fear. They were only the nominal object of the fight, and we—all of us—would see that they paid no more than anyone else—not a penny more. We knew the electrical industry, and we knew it would do its duty.

Then a strange thing happened. "It's a hard world," said the balloonist when he hit the ground, but not so hard as something is soft in the tops of a number of those who manage our affairs. Take the case of Bolton. Bolton Town Council received the Hackney appeal for support, and took no notice of it. Now, if it had been their football team that was in danger! Ah, that would have been another story. Meetings, processions, money, and everything necessary for fighting to victory there would have been, and in plenty. But it was only a half-million pound electricity works that was in danger, and the good of the town's industry. So these hard-headed, keen-as-mustard business men of Bolton received Hackney's appeal, doubtless recorded it on their minutes, and that was all. "What Lancashire thinks to-day, England thinks to-morrow." The Lord preserve us!

Then Hull. Hull is Yorkshire, and we all know that even the hard-headed Lancastrian yields to the man from Yorkshire. But Hull was not much better than Bolton. They have a half-million pound station which is growing in importance, but, judging from their response to the appeal, they think little of it. They gave something, to be sure, which is to their credit, but it is a small credit.

Other Committees have asked the Local Government Board, and have made the reply an excuse for doing nothing.



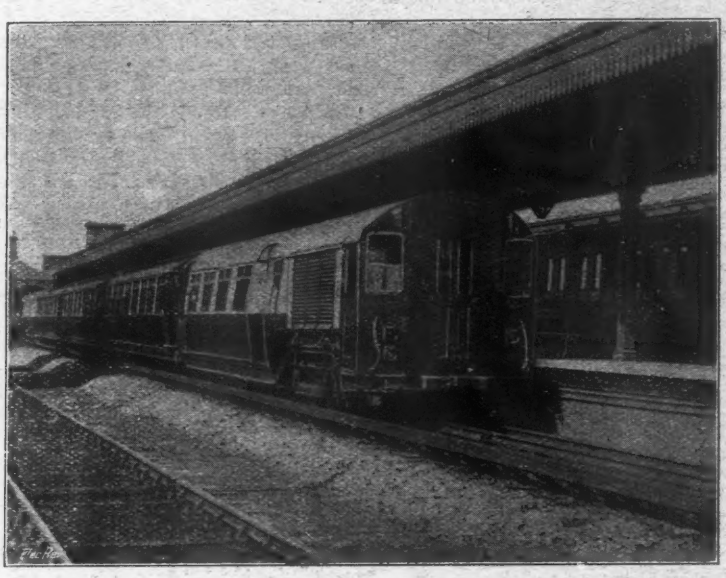
Sleet Brush Fitted to Truck, in "off" Position; Bakerloo—Watford Line.

As if they could not have voted it to their engineer as salary, and arranged for him to send it in his own name!

You people who are standing by, idly watching Hackney fight your fight, like so many Conscientious Objectors, have you ever thought that it would pay Hackney and the Gas Association to come to terms secretly, so as to promulgate a verdict which would give the gas people all they want?

They could even make it well worth while for Hackney to accept such a defeat. Then you would be squealing just as hard as the Conscientious Objector who found that the Zep. had bombed his shop!

Come along, electrical men! Be yourselves, be British! The very gas men will respect you if you fight them. But if you will not stand up for your rights, and if you are beaten for lack of energy to defend yourselves, then in Heaven's name take your whipping, and do not whine and call the gas men nasty names.



The Bakerloo-Watford Extension; Train in Watford Station (see page 423).

A LINKING-UP SCHEME: ACCRINGTON, HASLINGDEN, AND RAWTENSTALL.

Considerable interest is being shown at the present time in linking-up schemes, and it may be of interest to set out some of the details of the arrangement which has recently been put into operation between the Corporations of Accrington, Haslingden, and Rawtenstall.

Haslingden is situated about halfway between Accrington and Rawtenstall, and for the past five years has been served by a three-phase, 50-period, 6,000-volt alternating-current supply in bulk from the Accrington Corporation. The supply in Haslingden is distributed by that authority, and a number of important power consumers are now supplied from static transformer sub-stations, as well as from a three-phase, four-wire, low-tension alternating-current network in the centre of the town. A rotary converter is also provided to supply the tramway system.

Some few months ago it was decided to link up with Rawtenstall, which, fortunately, had the same pressure and frequency as Accrington, and by agreement between the three authorities, the cables and other works have been provided to give effect to this decision. Haslingden is at present taking about half its full requirements from each of the two generating authorities, and Accrington and Rawtenstall are placed in a position to be of mutual assistance to one another by means of the interconnecting mains. When necessary, of course, the whole of the Haslingden supply can be taken from one source. The arrangement is mutually beneficial to all three undertakings; Haslingden has the alternative of two supplies; Accrington and Rawtenstall can interchange power in an emergency or at light loads, and the interconnecting main is always in use for affording a regular supply to consumers in Haslingden and on the run of the main in Accrington and Rawtenstall.

The above arrangement is likely to be adopted wherever possible in the numerous linking-up schemes at present under consideration, as obviously it is most economical for interconnecting mains to be laid, not for emergency only, but to serve industries or towns on their route.

Under present circumstances it is not intended that the Accrington and Rawtenstall systems should regularly run in parallel, although the arrangement of the E.H.T. switchgear will enable this to be done, if found desirable, in the future.

The original supply from Accrington to Haslingden was by two feeders, each separately feeding a power transformer in the principal sub-station for local distribution, and an E.H.T. ring main to consumers' sub-stations. The low-tension mains from the transformers were brought to a three-phase, four-wire switchboard, and, by means of change-over switches, it was possible for either transformer to deal with the load. There was therefore duplicate apparatus throughout. This proved exceedingly useful when changing over to the new scheme, as it enabled all the alterations to be made without shutting down the supply. Fig. 2 illustrates part of the original arrangement, and fig. 3 shows the revised arrangement.

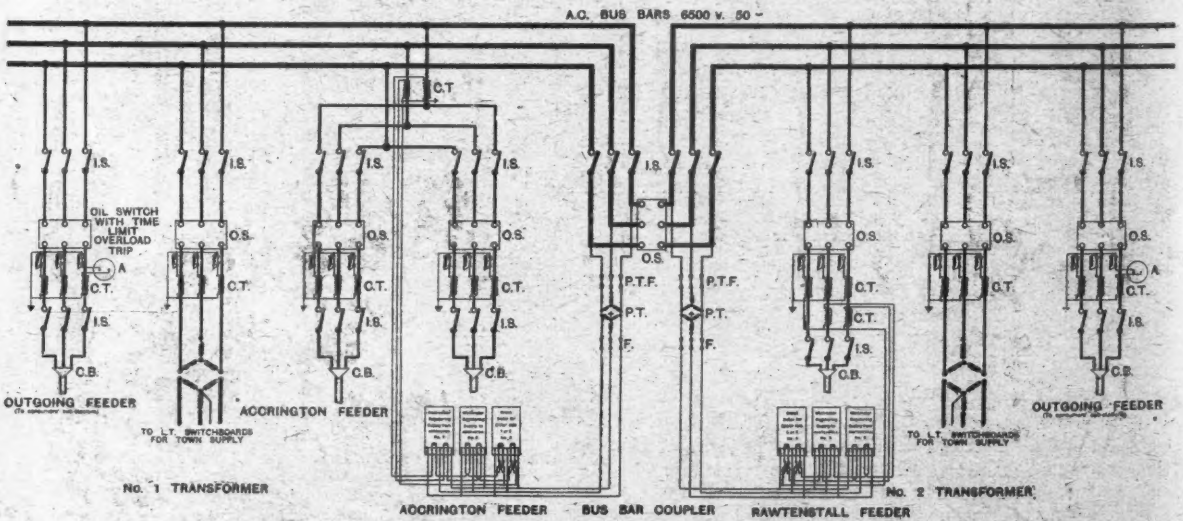


Fig. 1.—Diagram Showing Linking-up Connections.

Under the new scheme it was necessary to group all the E.H.T. cubicles together, and connect them to a common set of bus-bars, the two Accrington feeders being arranged on one side, and the Rawtenstall feeder on the opposite side of a bus-bar coupler switch. One power transformer and one-half of the ring main feeder is connected to each side, as shown in diagram, fig. 1.

With this design it is almost impossible that a total interruption can occur in the supply to Haslingden, as each

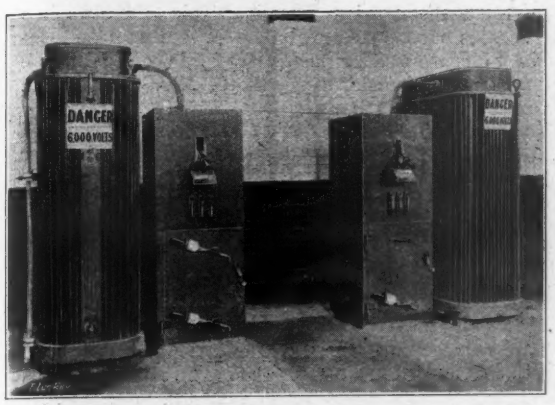


Fig. 2.—Original Feeder Switchgear, Haslingden.

half of the E.H.T. switchboard can be used absolutely independent of the other half.

The cubicles are equipped with the usual oil switches and isolators, together with the current and pressure transformers for operating the integrating wattmeters and automatic switches.

By reason of the necessity to obtain correct records, not only of the supply to Haslingden by either Accrington or Rawtenstall, but also of any interchange of supplies by the two generating authorities, special attention has had to be given to the meter equipment. Six unbalanced load wattmeters of the Aron type, with Merz maximum-demand attachment, are provided, one set of three being connected to the Accrington feeder, and the other set to the Rawtenstall feeder. Each meter is provided with a ratchet and pawl attachment to the gearing, so as to register the supply in one direction only, and one meter is used as a check against either of the other two.

It will be noticed from the diagram that each check meter is provided with a two D.P. non-break change-over reversing switches for the two current elements of the meter. With the switches in the top position, the current through both elements flows in one direction, and will check meter No. 1, whilst with the switches in the bottom position, the current will flow through the meter in the opposite direction, and check meter No. 2. In order to prevent the current transformer secondaries from being open-circuited, the switches are made of the non-break pattern.

There is no doubt that a metering arrangement of this kind presents some difficulties, especially when charges are based on the maximum demand principle, but these can be overcome by a little give and take on the part of the contract-parties, and are insignificant in comparison with the immense boon of interconnection.

The work has been designed and carried out under the direction of Mr. S. J. Watson, of Bury, the advisory engineer to the Haslingden Corporation; and the contractors for the E.H.T. switchgear were Messrs. Ferguson, Pailin & Co., Ltd. The E.H.T. mains between Haslingden and Rawtenstall were laid by the Rawtenstall Corporation, under the supervision of Mr. C. L. E. Stewart, borough electrical engineer.

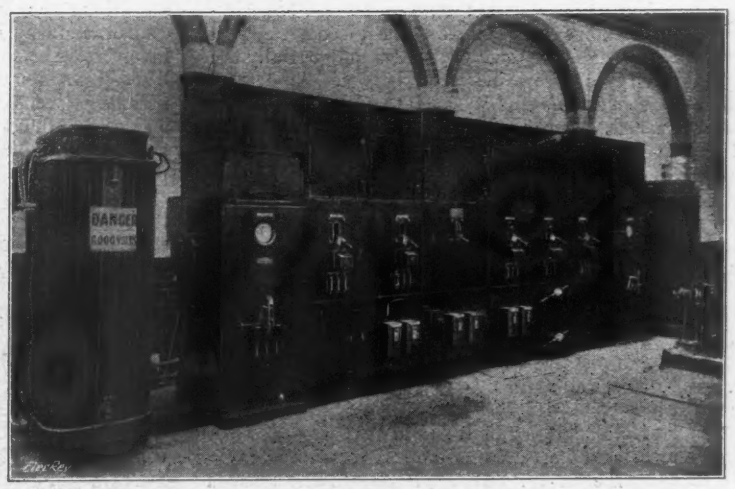


Fig. 3.—Re-arranged Switchgear at Haslingden, for linking up.

THE SUPPLY OF ELECTRICITY TO GREATER LONDON.

[COMMUNICATED.]

The announcement made recently that the President of the Board of Trade, Sir Albert Stanley, has appointed a Committee to consider and report what steps should be taken, whether by legislation or otherwise, to ensure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development, will be welcomed by all who have at heart the satisfactory progress of the electrical industry. The members of the Special Committee selected for this great task are men of tried ability and great experience. The choice reflects credit on Sir A. Stanley, and we cannot doubt that such professional and commercial men as are closely connected with the development of the industry will seize the opportunity, and give freely of their best should they be called upon to give evidence or assist in so great a cause.

It is difficult to realise the importance and magnitude of the task undertaken, but no one knows better than Sir Albert Stanley the inevitableness of tackling the problem, and we can only admire the promptness which he has shown in setting the wheels in motion.

No one, who had given the least thought to the matter, questioned, even before the war, the far-reaching importance of providing even a small community with cheap light, heat, and power in convenient form for industrial and social purposes; but recent events have shown that not only the power of local communities to produce, prosper, and add to the comfort and welfare of the individual is at stake, but also the very existence of a State depends on the provision, in an adequate and far-seeing way, of the supply of electrical power at a low cost. We say electrical power advisedly, for although under certain doubtful circumstances it might be found that some other form could be produced and distributed more cheaply, yet the adaptability of electricity to the needs of the nation in her great trial has proved its right to the premier position. We have only to look at our munition factories to grasp the truth.

As part of the problem of providing electrical power to all parts of Great Britain, the question of a cheap and efficient supply to London will form a weighty factor. It is generally accepted that development in Greater London

has been, in the past, most unsatisfactory. Although electricity has held out its helping hand to humanity since the early eighties, our Parliament, Government Departments, financiers, and engineers have brought forth to an uncomprehending community as sickly, ill-favoured, and ill-disposed a child as ever saw light of day. The child, ill-born, knows not itself nor its political parents, is wilful, perverse, and prone to fits, and the struggling millions who were to benefit so largely from this new gift of the gods "look up and are not fed." No doubt the new Committee in whose hands the welfare of the child will now lie, will diagnose the complaint and apply the proper remedy.

It is not difficult now to look back and see how the Electric Lighting Act of 1882, the original Act for granting Provisional Orders, has been, because of its narrow and limited conception, the great drag on successful development. In this Act the grant of the Order to companies or local authorities by the Board of Trade was limited to the too short period of 21 years, only to be extended by the Electric Lighting Act of 1888 to a period of 42 years. The local authority if not itself the owner of the Order would in 21 years be entitled to acquire the property of any company operating within its boundary. Neither Act legalised a standard pressure, or system of supply, and they may be likened to a measure giving powers to lay down in all parts of the kingdom and each district in London, railways differing from one another in track and loading gauge. The self-sufficient local authorities in London were thus set in their own water-tight compartments, and with the assistance of youthful and enthusiastic engineers evolved quaint schemes, interesting and to some degree instructive maybe, but carrying the seed of their own or their neighbours' ultimate destruction.

Sir Francis Marindin's inquiry, made at the instigation of the Board of Trade in 1889, into the questions as to whether lower pressure generating stations in the central districts would be, as compared with large high-pressure stations outside the central area, more economical, and as to the relative advantages of direct and alternating currents, resulted in both systems being established. The direct-current low-pressure undertakings were generally confined within parish or like boundaries, while the large alternating-current undertakings were given leave to compete with them over areas embracing many parishes, and generally the right of companies to combine was forbidden. Apparently this was the soft compromise so fatal to effective progress and development. Nevertheless companies were established, and commenced supply. The industry struggled along, weltering in this legislative soup, and it was found that by extending the area supplied and increasing the size of the power station, the cost of electricity could be reduced. In 1898 Parliament had many schemes before it for consideration, involving large scale supply in several parts of England. A Committee of both Houses, known as Lord Cross's Committee, was formed, and considered the matter. In their report they drew attention to the importance of electricity for power purposes as distinct from that of lighting, emphasised the advantage of generating on a larger scale than heretofore, and drew attention to the point that the supply of electricity in bulk and in retail were distinct questions.

In this year the L.C.C. and the local authorities within its boundary, in conference, decided that it would be desirable for the Council to supply to the local authorities electricity in bulk. This conference was the forerunner of various appeals to Parliament in 1902, 1903, 1904 and 1905, supported by the L.C.C., whose first important bulk supply scheme was introduced in 1906. The Bill of 1906 asked for powers to supply from Greenwich Power Station, in conjunction with a new station to be erected in Battersea, electricity in bulk to authorised distributors in the County of London, and in a large district outside. This Bill was thrown out by the Commons Committee on the ground of its being only permissive, whereas authorised distributors, it was contended, should be able to demand a supply if they required it. The Committee also disapproved of the proposed voltage of 6,600, and of the distribution scheme. They agreed, however, that the Council was the proper supply authority, and that they might either (1) do the whole work themselves, or (2), retain one part of the undertaking, and permit private enterprise to undertake the other part, or (3), lease the whole enterprise. A new Bill was prepared for 1907 to carry out the first recommendation, but after the elections in February of that year the policy of the Council changed, and the Bill was altered, so that a lease of the undertaking might be given to a private enterprise. The House of Commons Committee called for particulars of the terms of the lease and the name of the lessee, which the Council were unable to furnish, and the Bill was accordingly thrown out.

In 1908, the London Electric Supply Act came into force. This measure allowed nine of the London companies to connect their undertakings, in order to give mutual assistance, and empowered the L.C.C. to purchase the undertakings in 1931.

The Electric Lighting Act of 1909 authorised the Board of Trade to allow authorised undertakers to acquire land for generating stations compulsorily, or to supply in bulk, or to supply railways, &c., within their area with power to be used partly within and partly without the area, and, further, allowed linking-up to all authorised undertakers.

The London Electric Supply Act of 1909 included the remaining London companies within the provisions of the Act of 1908 as regards purchase by the L.C.C. in 1931.

Thus by 1909, the L.C.C., by its efforts, was charged with the responsibility of providing for the future an adequate and cheap supply of electricity in London.

In 1912, the Council referred the consideration of the whole matter to a Special Committee, presided over by Mr. G. H. Hume, one of the members selected for the Board of Trade Committee now formed. This Committee went into the matter most exhaustively, and just prior to the outbreak of war (in July, 1914) prepared their report, and submitted it to the Council in October of the same year. Its recommendations provided for the application to the whole of the London supply undertakings of a combination of municipal control and private operation, and suggested that "an arrangement might be made under which the capital required should be provided in definite proportions by the authority and a company, the company to have possession of the whole of the undertaking (including any undertakings acquired) for a definite period, subject to full powers of control and supervision by the authority." The scheme involved the co-operation of authorities outside the Council's boundary, and no compulsory purchase of existing undertakings was contemplated. As the report reads, "the key-note of the whole proposal is that an offer to the existing undertakings of a means of increasing the efficiency of their present undertakings, or, if they prefer it, an offer of a means of handing over their complete undertakings, upon terms to be agreed, to a central authority. Under the scheme put forward no immediate or drastic 'scrapping' of existing capital is contemplated, but a great increase in consumption and a reduction in the selling price will be effected at an early date."

Much water has passed under London Bridge, and the minds of all interested, both inside and outside the Council, have been steeped in the melting pot of the war since this report was written, and now, although the necessity for unification of general control and co-operation for all electricity undertakings within Greater London is freely granted, any successful scheme must, it is recognised, be freed from the paralysing effect of changing political influences, and be based on statesmanship of a high order and integrity. Although only a brief outline has been given of the development of the industry in London, sufficient has here been written to show that, patiently conceived and as patiently applied, measures will be required to counteract the ill-prepared plans of the past.

Let us hope that all who may be called upon to think, advise, and act on this great occasion so opportunely and so prominently offered, will remember one of the customs of our rude forefathers, which was periodically to burn in the person of their High Priest and King, the god they worshipped, in the hope that his spirit, having thrown off the paralysing coil of mortality, might return purified and strengthened with his sojourn in Spirit Land, and take up once more the work of material and spiritual assistance. Let us burn our old ideas, and seek guidance from a new

and wider vision of duty, and a truer perception of the meaning of the new dawn; heralding a blazing day when all other motives will give place to co-operation of capital, brainwork, and labour for the realisation of the material and artistic wants of our race.

Whether the capital certain to be required be derived from the individual *viâ* the coffers of a public authority, or from the individual *viâ* the purse of a private company, will not be, we venture to think, a matter of such great importance as the consideration of the due control to be exercised by the consumers over those interests, which will naturally centre round a low tariff. The administration and organisation offering the customer the best result will, no doubt, be the one ultimately adopted. The tariff, we venture to prophesy, will be so arranged as gradually to eliminate those stations—be they municipally or company owned—which cannot show ability to produce for a considerable time ahead, electricity at a cheaper rate than it can be delivered to their terminals by an adjoining company or public undertaking.

We welcome the Committee, if only as giving a lead to those clear definitions of policy so much required in anticipation of our boys' return from the war, and the then necessity of finding them useful work with the least possible delay.

We hail the formation of the Committee with the greatest satisfaction, and wish it every success.

THE ELECTRICAL EQUIPMENT OF MOTOR GARAGES.

There is undoubtedly a good field for enterprise in connection with the use of electricity in public and private motor garages, especially in large garages where petrol cars are overhauled. For inflating tires, for instance, a small motor-driven air-compressor, mounted on a truck so that it can be transferred from place to place, is exceedingly useful. Compressed air can be utilised not only for inflating tires, but also for cleaning upholstery, although a portable motor-driven vacuum cleaner is, perhaps, preferable for the latter purpose. In large public garages it may be better to install a stationary compressor. This arrangement, however, involves the provision of a pipe system and a fair-sized storage tank. Some American motor garages have been equipped with compressed air plant of this kind, but unless compressed air is likely to be required at more than one place at a time, the portable equipment leaves little to be desired. The electric motor, in the latter case, is usually started with an ordinary starting switch, whereas in the case of the stationary equipment an automatic pressure regulator starts and stops the motor at predetermined limits of air pressure.

Portable electric tools—such as drills, buffing machines, and grinders—are also of considerable value in connection with the repair and renovation of cars, for with their aid, work, which under ordinary conditions is difficult and tedious, can often be carried out with comparative ease. With portable electric drills, for instance, holes can be drilled in awkward places, and a great deal of work in the way of dismantling may, in certain cases, be avoided. Many mechanical engineers still exhibit a distinct preference for compressed air tools, which, of course, have proved very reliable; but electric tools offer certain advantages. The wires which supply the current are more flexible and more easily handled than the pipes used for compressed air. Moreover, electric tools are more efficient. Portable electric tools are made in two distinct types. In one case, the motor is combined with the drill, or whatever kind of tool it drives, whilst in the other case the motor drives the tool through a flexible shaft. The merits and demerits of these two arrangements are fairly obvious. In the former case, the power of the tool is limited by the weight of the motor, which has to be lifted into position; whereas in the latter case, the weight of the motor does not count, since the power is transmitted to the tool through a flexible shaft. A motor of the desired power can be mounted on a truck, which can be transferred from place to place in the same way as a portable air compressor or vacuum cleaner, and any amount of power within the capacity of the motor can be supplied to the tool through the flexible shaft. But this arrangement is only really necessary when the work is heavy, the combination of the motor and tool being quite satisfactory for almost all motor-car repair work. Tools of the latter type are more efficient than those involving the use of a flexible shaft. Flexible shafting, though quite satisfactory from a mechanical point of view, introduces a certain amount of loss in power, and is less easily handled than a flexible cable or wire. In motor garages, and, in fact, everywhere where electric tools are employed, the use of substantial leads for the supply of current is very essential. The leads of electric tools are nearly always subjected to very rough treatment, and unless properly insulated a great deal of trouble is liable to arise. The O.T.S. wires are very suitable for electric tools, because they will stand any amount of rough usage. For wiring garages, moreover, these wires offer advantages, especially when a cheap wiring system is required.

The heating of motor garages is a very important matter, and in this connection there appears to be a good opening for the electric radiator. If a motor garage be imperfectly heated during the winter months, the water in car radiators and cylinder jackets is apt to freeze. With the ordinary methods of heating there is, owing to the presence of petrol, considerable risk of fire, and it is for this reason that electric heating is advantageous. So far, however, few motor garages in this country are heated in this manner. The heating arrangements in some cases, in fact, are very inadequate, with the result that when the weather is severe, freezing troubles are occasionally met with. Freezing of the cooling water often results in cracked cylinder jackets and other damage to the cooling system, so that adequate heating is very important. Of course, such trouble can always be avoided by draining the water out of the cooling system every time the cars are put away, but this is a troublesome job that ought to be avoided. One method of heating garages, which has been adopted in America, is to draw hot air by means of an electrically-driven fan from a stove situated in an adjoining building, but the most convenient method is to employ electric heaters. For private motor garages in which freezing troubles occur most frequently, electric bonnet heaters are made which answer the purpose admirably. Heaters of this description consume very little current. They are made for pressures ranging from 12 to 240 volts, so that they can either be worked from the house service or from an accumulator. If the engine bonnet be covered with a rug, the heat supplied by the apparatus is quite sufficient to maintain the temperature of the water well above freezing point; indeed, it is said to keep the water warm enough to maintain the oil in a fluid condition, and thus allow the engine to be easily cranked when the time for starting arrives.

Although many motor-cars are now fitted with dynamos that charge the accumulators en route, and separate battery ignition is rather out of date, a fair amount of accumulator charging still has to be done in connection with the motor industry. When the supply is a continuous one the cells are usually connected in series with lamps, but many garage proprietors have no means of charging from A.C. mains. Central station engineers and others who may undertake the electrification of motor garages ought, under these conditions, to get some sort of rectifier or motor-generator installed. A small mercury-vapour rectifier might be used with advantage. If, however, the accumulator charging business is small, and low initial cost is an important consideration, use might be made of a Nodon valve. Although these chemical rectifiers have been displaced to a large extent by mercury-vapour and mechanical rectifiers, they are cheap, and can be manufactured by anyone possessing a little mechanical skill. A motor mechanic could easily make one if told how to proceed. Mercury-vapour and mechanical rectifiers, however, are more satisfactory, and where a fair amount of accumulator-charging has to be done, either a motor-generator or one or the other of these rectifiers ought to be employed. The hot-cathode argon gas rectifier described some time ago in the Electrical Review may also eventually prove useful for charging cells

belonging to motor-cars. The practical results obtained with this rectifier appear promising, but, so far, the apparatus has not been placed upon the English market.

In the future, electricity is sure to play an important part in the petrol car industry. Within the last few years, the electric lighting of cars has made remarkable headway, which is attributable very largely to the advent of the metallic-filament lamp. Half-watt motor-car lamps have recently been placed upon the market, but the candle-powers are at present too high for side and tail lights, and apparently they are intended for head lights. The introduction of these lamps should, however, considerably accelerate electric car lighting when normal conditions are restored. The starting of car engines by electricity has also been adopted within recent years, especially on American cars, many of which are now turned out complete with electric lighting and starting outfits. Not long ago the only part of a petrol vehicle that had any connection with electricity was the spark coil or magneto, and the average motor engineer knew little, and cared less, about electrical affairs. But the time appears to be coming when every large motor garage will require the services of an experienced electrician to carry out or supervise electrical repairs. Moreover, when electric vehicles are used more extensively, existing motor garages may be provided with charging arrangements. All electrical engineers recognise that if the electric vehicle is to make headway in this country, adequate charging facilities must be provided, and it seems that steps ought to be taken at the earliest opportunity to get large motor garage proprietors, in districts where there is likely to be a demand for current, to make arrangements for the installation of charging equipments on the standard lines recommended by the Electrical Vehicle Committee of the I.M.E.A.

THE NATIONAL SERVICE OF THE PRESS.

The United States Congress has recently rejected a proposal, embodied in the Post Office Appropriation Bill, for increasing the postage rate upon periodicals. In coming to this decision, Congress has shown consideration for some of the highest interests of the national life, and has set an example which might well be emulated by other Governments nearer Home. The American *Electrical Review and Western Electrician*, in commenting upon the matter, remarks that the taxation of journals in the manner proposed is not a matter affecting the publisher and subscriber alone, but one with which the nation, as a whole, is very closely concerned. "Many of the journals are a national asset of a high order, for they are doing a magnificent work in the service of the country." If this statement fairly applied in the case of the journals in the United States before it had actually accepted Germany's challenge, how much more will it do so under the actual conditions of war, and still how much more must it be so here, where journals of many kinds have acted during the war in such close co-operation with the Government, assisting it in its propaganda as new and serious situations have arisen. The Forces never could have conducted their operations on such a scale had not the assistance of the Press been availed of so freely. The publicity that has been given to requirements in such matters as finance, men, munitions, and food, has been of the greatest possible value, and it has been freely and efficiently accorded. But it is not merely in actual publicity that the Press has assisted the Allied effort; in a variety of other ways specialised co-operation, such as trade journals, by virtue of their experience and available sources of information, are alone able to render, has drawn from Government officials such remarks as: "We are absolutely unable to do without you at the present time." Yet apart altogether from such matters as publicity and specialised information, there are other reasons of wider application which would seem to justify the fullest possible consideration in reason being extended to trade journals, so that in these times of stress and shortage they may be enabled to maintain, as far as practicable, their standard of efficiency and usefulness. We quote the following extracts from our aforesaid American contemporary because of their timeliness, and because in these days it is all too easy for such points to be lost sight of:—

> Many of the journals are a national asset of a high order, for they are doing a magnificent work in the service of the country. The imposition of increased postage would restrict circulation, place an additional burden upon the publisher, and one which would have to be borne eventually, if not immediately, by the reading public. As it is, the present high price of paper is working a hardship with many of the nation's periodicals; in some instances, subscriptions have already been increased, in others, circulation curtailed and reading matter retrenched, to the detriment of the publisher, the subscriber, and the advertiser.
>
> The work of many journals is not merely individual, but national. Perhaps no two things have done more to bring North and South, East and West, close together than have the railroads and the nation's journals. By means of low postage rates, it has been possible to dispatch these journals broadcast over the country, placing them within the financial reach of everyone. Many of these technical journals, whether in the field of engineering, medicine, law, art, or any other domestic, industrial, or scientific sphere of endeavour, are fulfilling a function impossible to evaluate. They are circulating knowledge and experience, creating inspiration, building incentive from the example set by others, and making possible the intimate exchange of ideas. To the credit of the technical journals, in no small measure, is due the rapid development of civilisation and human progress of the last decade. The technical journal brings one into intimate contact with the world's work, and dreams and aspirations and accomplishments of others; through it you learn what the world is doing, how it is doing it, and why. The technical journal imparts information, it suggests, inspires, creates, and guides. Surely, this is the most efficient manner of using knowledge, and permits of its utilisation to the best advantage.
>
> The technical periodical is not a luxury. It is a necessity. It is necessary to the engineer, or anyone else endeavouring to keep abreast in his profession or calling and obtain eminence in his domain. To remain uninformed to-day, is not merely to stagnate, but is to fall behind. Things move with such rapidity in these days, that one must either keep pace or be lost in oblivion. One cannot mark time. New methods and new demands, new ways of meeting old needs arise, and make the rapid circulation of knowledge of greater necessity and value now than it ever was before.

A short time ago, in an article on "National Service in Germany," which appeared in the *Daily Telegraph*, a Special Correspondent stated that the German Government promised, in the Reichstag, that journalists and those engaged in educational work would not be called upon for service under the Act. The necessity for maintaining publicity services and securing reasonable continuity in connection therewith as a means for assisting to hold things together, was apparently recognised. In a more recent article, which appeared in the *Times*, that journal's correspondent, formerly in Berlin, described the German Press as being unaffected by the war, the Government having regarded the importance of publicity abroad and at home as indisputable. It also desired, as part of its Press strategy, to maintain "the Press in the highest possible state of efficiency, with a view to instant operations on the conclusion of Peace." "The exportation of German newspapers and periodicals of all sorts is encouraged, not only with utter disregard to trade policy, but with complete indifference to the cost." It is part of the policy of the enemy to make opinion in neutral countries, and to that end "German papers are scattered, free of cost, through the hotels of Scandinavia, Holland, Switzerland and Spain, and every encouragement is given to the increase of their foreign circulation." Germany is exhausting every possible source of man-power and energy, is cutting off all unnecessary manufactures, but it is conducting a large and remarkable newspaper policy involving very special efforts. "As regards man-power," says the *Times* writer, "the newspapers have throughout received special consideration from the military authorities, being treated on much the same basis as Government offices, which in Germany enjoy no general rights of exemption, but retain such man-power as is absolutely necessary for efficiency. Similarly, under the National Service scheme, the Press will be affected only in so far as inquiry may prove it to be over-staffed."

We believe that the business men in our own Government will not desire to be behind America and Germany in appreciating the necessity for enabling British periodicals, upon which so much must depend in connection with trade development and expansion after the war, to continue, with the smallest possible handicap, to perform their national, colonial, international, and general industrial service.

NATIONAL INSURANCE (PART II) (MUNITION WORKERS) ACT, 1916.

Contributions are payable in respect of :—

2,148 X. Workmen who are employed in an establishment carrying on any trade insured under the National Insurance (Part II) (Munition Workers) Act, 1916 ; and who are engaged in cleaning locomotives or other vehicles which are used mainly on the premises of the establishment.

2,152 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the manufacture of metal springs of any kind.

2,153 X. Workmen engaged in making metal name plates and metal letters for fixing on buildings.

2,154 X. Workmen engaged in cutting down old wooden cases, and remaking into cases of a different size.

2,159 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the manufacture or repair of anchors, chains, chain couplings, and miscellaneous chain attachments of metal.

2,161 X. Workmen engaged in the repair of biscuit tins, oil and colour tins, &c.

2,165 X. Workmen engaged in the manufacture (including cold rolling, galvanising) of flexible metallic tubing, including workmen engaged in preparing rubber for, or making rubber parts of, such tubing.

2,166 X. Tinsmiths engaged in the manufacture of navigation and other lanterns.

2,169 X. Workmen engaged in the manufacture of speedometers.

2,170 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged wholly or mainly in the manufacture of iron, steel or other metal hardware and hollow-ware.

2,174 X. Workmen (other than those already insurable under Part II of the National Insurance Act, 1911) engaged in the repair, including sharpening, of metal hand tools.

2,176 X. Workmen engaged in the manufacture of rubber tires and elastic air tubes for motors, cycles or other vehicles.

2,177 X. Workmen engaged in making sheet, pipe or pig lead, in rolling lead, or in making lead pipes.

Contributions are not payable in respect of :—

2,155. Workmen engaged in fixing name-plates and letters on buildings.

2,156. Workmen employed as engine tenters or as stokers in connection with uninsured trades.

2,157. Persons employed wholly or mainly as draughtsmen, tracers, office attendants, office messengers, commissionaires, clerks, typists.

2,158. Overlookers, chargehands, storekeepers, warehousemen, when not employed wholly or mainly by way of manual labour.

2,160. Workmen employed by a Town Council, and engaged in sweeping streets, emptying ashpits, or as attendants at a refuse destructor.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

New Mining Electric Bell.

In a paper read before the East of Scotland Branch of the Association of Mining Electrical Engineers by Mr. L. H. Howlett, and reported in the *Iron and Coal Trades Review*, a description was given of a bell specially designed for use in coal mines, where it is necessary to obtain a loud ring without using so much current that there is a danger of igniting mixtures of firedamp and air. The construction of the bell is shown in fig. 1, and its mode of action is as follows :—Current passes from the terminal T_2 to the flexible brass strip *s*, which is held against the platinum screw contact P_2 by the spring S ; from P_2 it goes through the bobbin A to the terminal T_1, as shown by the dotted lines. The armature is attracted by A, with the result that the gong G is hit by the rod *h*, contact being broken with P_2 and made with P_1. The current is now stopped through A, and travels instead through B, as shown by the dotted lines from P_1. The armature is pulled back by B, and the other end of *h* hits the gong ; contact is renewed between *s* and P_2, A is again magnetised, and so on.

The hammer H has an iron rod *h* screwed into it, so as to strike the gong at both ends of the stroke ; when the bell is at rest, *h* should be equidistant from the gong at both ends. The contact screws on P_1 and P_2 are brought as close together as they can be without *s* touching both ; they must also be arranged so that when at rest the armature is equidistant from the iron cores of A and B.

The connections to the bobbins A and B are so arranged that the current appears to go round them in opposite directions if they are looked at from the screw *t* at the end of A. The magnetic circuit for each iron core is completed by a vertical side piece to the iron base I, and thence through the axis *a* of the armature, to the armature itself. The gong G is screwed by means of an iron bolt and nuts to a vertical piece V, rising from the base I.

The minimum igniting current of the bell (*i.e.*, the smallest current whose break-spark can ignite the most sensitive firedamp-air mixture when the bell is in circuit), was found to be 0·18 amp. The smallest current that would cause the bell to ring was 0·04 amp. The resistance of each bobbin was 24 ohms. The rate of ringing at the minimum igniting current (0·18 amp.) was found by means of the oscillograph to be 2,880 strokes per minute. By removing the bobbin B and the contact P_1, and shortening one end of *h* (the end nearest to T_2), so that it cannot strike the gong, an ordinary type of single-action bell is left. When this was done

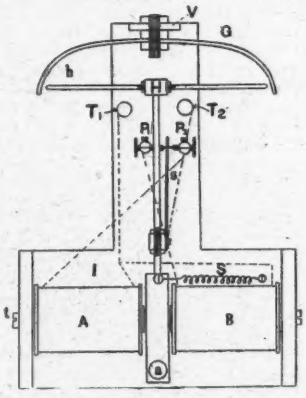


Fig. 1.—New Mining Electric Bell.

the minimum igniting current and minimum ringing current were found to be unchanged, but the number of strokes per minute fell to 1,310 ; there was therefore a loss in ringing power.

By the addition of the bobbin B and the contact P_1 the return stroke of the hammer can be quickened and utilised by making the hammer strike the gong again. The addition of the bobbin B involves no increase in the self-induction of the bell ; it does not therefore become more liable to ignite firedamp mixtures. When a well-constructed bell of the ordinary type is ringing, the current is cut off for about 40 per cent. of the time. In this bell, on the other hand, the current passes practically all the time, as shown by the oscillograph records. Dr. Wheeler allowed this bell to be made and tested at the Home Office Experimental Station, Eskmeals.

Arc Welding Plant.

Messrs. Tilling-Stevens, Ltd., of Victoria Works, Maidstone, have utilised the equipment of their petrol-electric chassis for the development of a mobile arc-welding plant, the dynamo and motor of the chassis being specially wound for this class of work, in which they specialise. The firm also make motor-generators for arc welding, and have supplied welding plant to a large number of important firms in this country, with highly successful results. The accompanying illustration shows one of their equipments in use. Power is derived from the petrol engine, and serves to propel the vehicle by means of the Tilling-Stevens electric transmission, as well as to supply the current for welding, the motor, in the latter case, being cut out of circuit. The body of the vehicle is used to house the welding apparatus, and as a messroom and workshop ; the vehicle can, however, be built in the form of a lorry, the welding plant being then carried in a locker at the

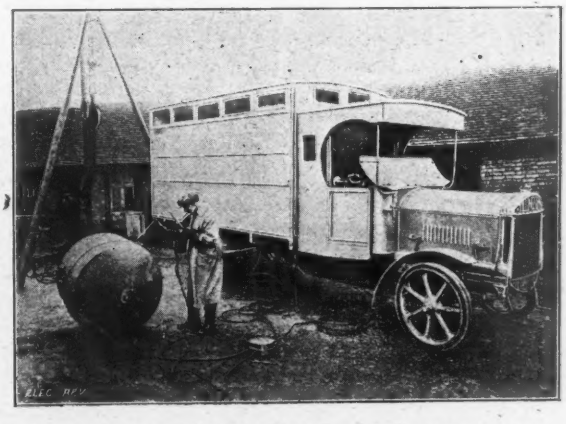


Fig. 2.—Tilling-Stevens Mobile Arc-Welding Plant.

back of the cab, so that the whole of the space on the lorry can be utilised for ordinary cartage purposes. Regulation of the welding current is effected by means of an artificial load, which is cut out by a relay switch when the arc is struck, and immediately restored when the arc is broken. A large range of adjustment of voltage and current is provided for. Obviously the outfit can be applied to many other purposes besides arc-welding, and something of this kind would appear to be ideal for the application of electric power to agricultural operations in places where a public supply is not available. Either carbon or metal electrodes can be

used for the welding process, and the flexibility of this system renders it applicable to an extraordinary variety of operations.

Motor-Control Panels.

We have received from the British Thomson-Houston Co., Ltd., of Rugby, particulars of their "A.T.M." motor-control panels for A.C. circuits, which are designed for starting polyphase slip-ring induction motors against full-load torque; the equipment comprises a baseplate carrying a starting rheostat and switch-fuse, complying with the Home Office rules for the use of electricity in factories, and without any exposed live metal. The panels are standardised for circuits up to 550 volts, 25 to 60 cycles, taking a stator current not exceeding 48 amperes at full load (equivalent to 30 H.P. at 400 volts) and a rotor current not exceeding 125 amperes. The switch-fuse is of the quick-break type, enclosed in a cast-iron case, with the movable parts attached to the hinged cover, which cannot be opened while the switch is

Fig. 3.—B.T.H. Motor-Control Panel, Form G2.

closed; the fuses can be rewired. The starting rheostat is enclosed in a cast-iron case, with a glazed opening for inspection of the switch and contacts; it may or may not have stator contacts—in the former case, being fitted with a low-voltage and two overload trips for returning the starting switch to the "off" position. The larger sizes have a slow-motion device to prevent the starter arm from being moved over too quickly. Fig. 3 shows one of the larger patterns, with cover off the starting switch and the switch-fuse open. Meters can be fitted if desired.

The Garrett Safety Control Gear for Electric Motor Vehicles.

Mr. F. Garrett, managing director of Messrs. Richard Garrett and Sons, Ltd., engineers, of Leiston, Suffolk, has recently taken out a patent for a special arrangement of the control gear for electric motor vehicles, by which, whenever either the foot or hand brakes of the vehicle are applied, the current controller is automatically brought to the neutral position independently of the driver, thus avoiding the throwing of extra load on the batteries and the

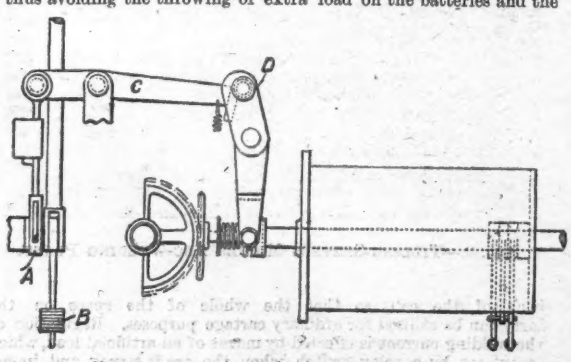


Fig. 4.—Garrett Safety Control Gear.

motor, and consequent damage. The arrangement is shown diagrammatically in the accompanying illustration, fig. 4; it will be seen that when either the hand or foot brake levers A and B are operated, not only are the brakes applied, but the lever C is moved in an anti-clockwise direction; by reason of the cam-shaped right-hand end of this lever the vertical lever D moves in a clockwise direction, and, through its connections, severs the contact between the lever of the hand controller and the controller drum. By the action of a pair of springs, the drum at the same time automatically returns to the neutral position. The controller handle and the brakes are also so linked together that it is impossible for the driver to start the vehicle with either of the brakes on.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Johannesburg Cable Trouble.

I have just read the announcement in your issue of the 16th ult., under the above heading. May I be allowed to draw your attention to the implied reflections therein contained upon the wisdom of the consulting engineers who specified, and the skill of the manufacturers who supplied and laid, the direct-current feeders in question?

I am sure you had no intention of making any such imputations when editing your note; and as I was resident in Johannesburg at the time these cables were laid, I hope you will allow me, in the interests of fair play, to add certain information concerning the causes which have necessitated their renewal after the relatively short life of about 12 years.

Your note describes the cables, but no mention is made of the fact that they were laid directly in the ground, without any external protection or warning board to indicate their presence to subsequent excavators.

They were no sooner laid than the streets through which they passed were repeatedly opened by crude native labour engaged on the sewerage, telephone, water, and other public utility services throughout the area.

I have personally seen these buried cables treated as though they were merely tree roots, or other trench obstructions, and hacked out of the way by natives whose brute strength was more in evidence than their intelligence.

Occasionally a direct blow of a pick would reach the conductor, when the damage, of course, declared itself immediately; but in countless other cases, incipient faults were undoubtedly set up which time alone could develop. The wonder is that this ill-treatment has been so long in bearing fruit.

The uninitiated may point out that, according to your announcement, the ultimate breakdowns were due to the decentralisation of the conductor, and the connection between mechanical injury and decentralisation may not be very obvious at the first glance.

It has, however, been authoritatively established (*vide* I.E.E. *Journal*, Vol. LIII, Nos. 238 and 243) that the passage of leakage currents—such as would be set up between neighbouring faults caused by mechanical injury—softens the vulcanised bitumen, and this effect would naturally lead to the decentralisation to which you have referred.

The somewhat drastic attempted remedy of stripping off the armour and relaying the de-armoured cables on the solid system was naturally attended by serious risks, as it involved forceful handling of heavy cables whose dielectric had already been seriously weakened physically as well as electrically by the effects of the above-mentioned leakage currents.

Afrikander.

Municipal Electrical Publicity.

In Mr. E. P. Hollis's thoughtful and interesting communication on the above, he makes little of the uses of literature in connection with a publicity campaign; now, I have found by carefully watching the results of various means of getting electrical business in private houses, that a well-prepared pamphlet is productive of excellent results, if such literature is drawn up in attractive style, on good class paper, by a good printer. Unfortunately the majority of brochures, &c., which we are able to get are rarely appealing enough to attract the attention of the private consumer, and it was here that the late Joint Publicity Committee really scored; their publications were exceedingly well drawn up, especially so in the earlier days, dealing with only one subject at a time, and the literature *multum in parvo*. It is one of the commonest faults in the preparation of pamphlets to make the wording too lengthy; the average man will not wade through it, however well and correctly it may be written. A stylish picture with a few short, well-thought-out paragraphs, dealing with the essential points of whatever one wishes to impress on the reader, easily readable and digested at a glance, printed on a two-page folder of a size convenient enough to go into an ordinary business envelope, and posted with a penny stamp, is without doubt read and appreciated by everybody to whom it may be sent.

It is a mistake to send more than one subject at a time, or to bombard the district frequently. Such mail advertising should be done in a very systematic way, careful records being kept of what class or subject has brought the best results; and it is really surprising to observe, by examining such records, the number of inquiries that undoubtedly accrue directly from such mailing. I do not wish to convey that this alone should be used, as it is most necessary periodically to follow up with a personal call; but here comes the difficulty. In normal times it is of very rare occurrence that one can obtain a really systematic and conscientious man, who

has got his heart in his job, and of all the men for this class of work who have passed through my hands, I can only remember one who was worth more than he was paid. A man, to be really good, must be an enthusiast, and I am inclined to think that the word "canvasser" applied to such jobs does a great deal to stop men from adopting this very interesting, and far from monotonous, branch of the electrical profession. It is not a door-knocking job by any means; in fact, the amount of domestic business obtained by direct canvassing on a "door-to-door" method is not worth the time and trouble. The man should not be treated as a canvasser—he should be a representative of the supply company who is as interested in the prospective consumer as he is in the undertaking. He should be a trained engineer, with a bond behind his word.

The department controlling such business development should have central offices, with a well-equipped showroom, not an array of all sorts and conditions of apparatus, so that the intending consumer is baffled in choosing, but a good selection of every apparatus which results have proved to be good; that is to say, the electrical kettle recommended should be one of the two best makes, the stove the same, and so on, so that the client can be advised at once of what the supply undertaking considers to be the best, and when such a piece of apparatus is out of date, it should be scrapped. How often one sees in electrical showrooms antiquated models of utensils, &c., which should have been broken up long ago; and it is here that the local contractors could help, if they would, by suggesting, at periodical meetings, what, in their opinion, is best; but, for some reason or other, there seems to be, except in the minority, no cohesion between them and the supply authority, though both are essential to one another.

Mr. E. P. Hollis's paragraph on introducing articles which consume a very small amount of current is very true; a vacuum cleaner, hair dryer, or a fan, consumes so little that, on first thoughts, it hardly seems worth while pushing them, but these small fry do a great deal to popularise the domestic uses of electricity, and are a pleasing prelude to more productive business.

In conclusion, the whole subject of publicity work in connection with an electrical undertaking is of such vast importance to business development, and its management, methods and results are such an interesting and absorbing subject, that I often wonder why more enthusiasm is not shown, or more encouragement given to us in England.

A. G. Bostel.

Croydon Electricity Supply,
April 16th, 1917.

Boiler-House Operation.

Messrs. Otley and Pickles's paper, Table I, shows that the Rand Power Co. use large-unit, wide boilers, the average rating exceeding 30,000 lb. steam hourly each. Table III shows the excellent load factors; and Table VI shows that at Rosherville, burning good coal, 3·35 KW.-hour × 3,411½—viz., 11,429 B.TH.U. per. lb as fired, at 23·8 lb. per sq. ft. of grates, with fan draught, the steel-cased boiler with superheater and economiser, all in clean condition, gives 78·7 per cent. efficiency.

As the Rosherville coal is stated to have about 15 per cent. ash, this test was presumably made with peas or nuts, which can be burnt without wetting. But, for all fuels except peas and nuts, it is clearly shown that good combustion on chain-grates necessitates careful wetting of the coal as it descends the chutes from overhead bunkers, so that it is neither too dry nor too wet for the stokers.

At Vereeniging, with the extraordinarily high load factor of 67·4 per cent., the fuel averages only about 18½ per cent. ash, but in the wetted condition as fired, it is only 2·88 KW.-hours—viz., 9,825 B.TH.U. per lb.; and on this basis, the efficiency is 75 per cent., including economiser, but falls to 67·7 per cent. when the coal is dusty. It seems clear that on dry samples this coal would be about 11,000 B.TH.U. per lb., and on that basis the efficiency would naturally be much less.

It is only in the small Brakpan station that low-grade fuel, averaging 27 per cent. ash, is burnt; but, with the exception of nuts and peas, all fuels burnt are artificially wetted to suit the stokers.

It is interesting to compare these large-unit, steel-cased, cross-drum boilers of the Rand Power Co. with the largest units of the same type in America, viz.:—

Cross-drum, steel-cased units.	Rand Power Co. (as fig. 6.)	Chicago. Edison.	Essex, N.J. P.S. Corpn.
Inside width of furnace	21 ft. 0 in.	24 ft. 10 in.	24 ft. 10 in.
Number of tubes ..	45 × 14, 630	42 × 14, 588	42 × 16, 692
Length and diameter ..	11½ ft. 3½ in.	18 ft. 4 in.	18 ft. 4 in. dia.
Boiler heating surface ..	6,200	12,200	13,727 sq. ft.
Superheater ,,	2,333	2,400	1,711 ,,
Economiser ,,	3,610	6,566	7,750 ,,
Coking arches	2 each 9 × 2 ft.	2 each 10½ ft. × 8 ft.	None
Stokers	2 chain-grates	2 chain-grates	One 16-retort
Grate surface	252 sq. ft.	273 sq. ft.	Riley, no grates

Any of these large-unit boilers can be properly compared with one-half of a double-ended boiler at Detroit; the latter is 26½ ft. inside width of furnace, with 53 tubes wide, 3½ in. diameter, 11,827 sq. ft., plus 1,200 sq. ft. superheater; no economiser used; 13-retort stoker with archless setting. With good coal burnt in dry condition, 76 per cent. efficiency is attained with no economiser.

British practice with the Erith-Riley continuous-cleaning stokers, even when burning low-grade coal in dry condition, with as much as 24 per cent. actual ash by analysis, and about 9,500 B.TH.U. per lb. on smaller units of various makes of boilers, shows that with this entirely underfeed combustion the boiler efficiency is so high that in most cases the economiser and induced draught fan are omitted as not worth while thus greatly simplifying the boiler plant.

Where short-tube boilers are adopted, with small heating surface and water capacity for a given width and duty, the overhead economiser is generally retained; thus for a 21-ft. boiler (of same type as Rand Power Co.'s units) in Lancashire, the 12-retort Erith-Riley stoker, with archless setting, is adopted to burn without wetting slack with about 20 per cent. actual ash, for 50,000 lb. hourly evaporation on boiler 45 × 18 tubes, 8,000 sq. ft. heating surface, with superheater and overhead economiser.

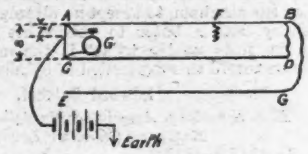
At the Chicago Edison plant, with chain-grates, the fuel is wetted in the same way as the Rand Power Co.'s fuels; but both in America and in England, the expert regulation for such watering, as well as the loss of capacity and the increased coal consumption it involves, are entirely avoided wherever the modern multiple-retort continuous-cleaning stoker is adopted, and this method is equally applicable to every make and size of water-tube boiler.

Charles Erith, A.M.I.Mech.E.

London, E.C., *April 16th*, 1917.

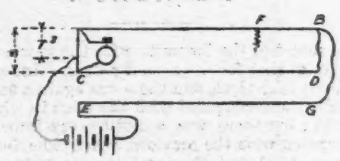
Fault Localisation.

In reply to your correspondent's query under the above heading, the following should give an accurate result. First couple up with a slide-wire bridge thus:—



A B = One faulty feeder.
C D = 1st trolley wire.
E G = 2nd ,, ,,

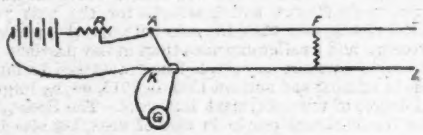
Obtain balance on the galvanometer. Secondly, couple up with the slide-wire bridge thus:—



Obtain balance again on the galvanometer.

The position of fault from the testing end is $r_1 \times AB/r_2$. This method obviates the necessity of knowing the resistance of the return wire. A simple loop method with one trolley wire will give a false result, as the trolley wire is of hard-drawn copper, and its resistance, according to its sectional area, cannot be compared with that of the cable under test.

This adaptation of Murray's loop test should be confirmed by a drop-of-potential test to check any error, due to fault resistance, thus:—



A B = No. 1 feeder.
K L = No. 2 ,,

Reading No. 1, as connected gives drop A F K.

Reading No. 2, galvo B to L, gives fault resistance.

Then take similar readings from the other end; B L and A K should be the same. If not, subtract the mean of these from A F K and B F L. Then distance of fault from A = A F K × length of A B (A F K + B F L).

H. E. Blake, A.M.I.E.E.,
Mains Superintendent.

Eastbourne, *April 2nd*, 1917.

The I.E.E. Nominations.

With reference to the question of the election of Mr. C. H. Wordingham to the Presidency of the Institution, the nomination seems to be especially impolitic at the present moment. Mr. Wordingham is engineer-in-chief to a Government department. Probably in the near future the Government departments will be drafting new regulations dealing with one or other of the sections of the electrical industry, and it is quite conceivable that the industry may not always see eye to eye with the Government departments. In such cases, how could Mr. Wordingham properly represent the industry?

The Institution ought to exist for the protection of the industry, and to elect as president a Government official at the present time would be about as sensible as if a ratepayers' protection association chose as their chairman one of the clerks in the local rates collector's office. Would it not have been ridiculous for an Admiralty official to have headed the deputation representing the electricity supply industry, which a

few days ago waited upon the Reserved Occupations Committee, as the present President did? This would have meant that an Admiralty official would have taken the lead in arguing points against the Admiralty and War Office representatives sitting on the other side of the table. If the new Board of Trade Electrical Committee have to be approached by the I.E.E., how could the President of the Board of Trade receive the paid official of another Government Department representing a critical and protesting deputation? Now, more than at any other time, it is imperative that we should have a President unfettered by his official position who can be relied upon to do his utmost in support of our industry. To be placed in such an embarrassing position as Mr. Wordingham would have to occupy would obviously be unfair to Mr. Wordingham himself.

L. L. Robinson.

London, E., *April 17th*, 1917.

You may be interested to know that at a meeting of the Associated Municipal Electrical Engineers of Greater London, which took place last Monday, the question of the presidency of the I.E.E. was considered, and disappointment was expressed at the nomination of Mr. Wordingham, in present circumstances, especially in view of possible negotiations with Government departments, he being a Government official. It was decided to ask Mr. Chattock, of Birmingham, to accept an alternative nomination for the presidency, and a letter to this effect was dispatched. Unfortunately, he feels unable to act in the matter, but it is desired to place on record this expression of opinion.

Edward Calvert,

Hon. Secretary, Associated Municipal Electrical Engineers (Greater London).

London, N., *April 17th*, 1917.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

The annual report of the Committee for the year ending December 31st, 1916, states that for the second year in succession the annual festival did not take place, and there was again a serious falling-off in the contributions compared with the years in which the festival had been held; but there was a satisfactory improvement in the receipts compared with the previous year. The income from contributions was £609, and the total income £944; the net income was £796, out of which grants had been made (amounting to £64), and £595 had been invested, bringing the total of the invested funds up to £8,711. Applications for relief were fewer, and every qualified applicant received assistance. The Committee expresses a hope that heads of firms will assist the Institution by appointing collectors, and by bringing the advantages of membership to the notice of their staffs.

The annual general meeting of the Institution was held on Monday last, April 16th, at the Institution of Civil Engineers. Mr. A. A. Campbell-Swinton presided, and after the minutes of the last annual general meeting had been read, moved the adoption of the Committee's Report and Accounts for the past year. Mr. Campbell-Swinton said that the accounts, on the whole, showed larger receipts and smaller expenses than in the previous year, but the differences were not very great. The grants paid during the year were less in number and amount than in 1915, owing largely to the lessened degree of unemployment last year. The Society not only provided for electrical people in case of need, but also laid itself out to find employment for them, and last year it had been exceptionally successful in this respect. There was a satisfactory increase in the subscriptions of members (from £93 to £150), but, unfortunately, there were no donations from life members and governors, owing to the financial conditions of the times. The total subscriptions had not varied greatly, being £270, as compared with £300. They had a credit balance of nearly £9,000—could they not, by a little effort, increase it to £10,000? With a view to inducing others to assist towards this end, he would set the example by contributing a gift of £100 to the funds. It was true that the time was very unfavourable to the raising of subscriptions, as many professional men had been hard hit; but, nevertheless, the attempt should be made. There was a considerable falling-off in income owing to the suspension of the festival; in 1914 the net receipts were £3,127, while last year they were £796, the difference being accounted for by the omission of the dinner. Moreover, as the Electrical Engineers' Ball did not take place, the usual donation out of its surplus funds was not received. The Society dealt with the electrical trades in general, the Institution of Electrical Engineers and other bodies having their own benevolent funds; the Society provided for employés who did not belong to those institutions or to trade unions. Mr. Justus Eck, who had worked very hard for the Benevolent Institution almost from its inception, resigned at the last meeting, and they accepted his resignation with regret.

Mr. W. B. Esson, in seconding the resolution, referred to the great need of such an Institution, and pointed out that though it was not called upon last year to make many grants, immediately the war ended there would be a large demand for its assistance. He congratulated the chairman upon becoming a Life Governor, and said he would like to see the number of such increased from 8 to 20; every donation of £100 by a Life Governor went to build up their capital, and until a large capital sum was available they were hampered in granting pensions, to do which was one of the principal objects of the Institution.

The secretary, Mr. F. B. O. Hawes, remarked that having in view the omission of the festival dinner, the finances of the Institution were in a very favourable state, as the contributions of the members had increased from £93 to £150, and those of annual subscribers from £87 to £120, which was also a sign of strength. As donations they had not received any "plums" such as had fallen to them in previous years, but the total in comparatively small amounts had increased from £284 to £338. He cordially endorsed Mr. Esson's appeal—to bring the investments up to £10,000; the electrical industry was doing very well indeed, and he appealed to the manufacturing branch to increase the invested sum to more than that amount. He hoped that Mr. Campbell-Swinton's example would be followed by many who were able to do likewise.

The report and accounts were adopted unanimously, and the chairman proceeded to the election of the Committee for the year.

Messrs. Esson, Garcke, Gatehouse, Hunter, Ratcliffe-Small, Sir Ernest Spencer, and Messrs. Campbell-Swinton and L. Thurnauer retired by rotation, and were eligible for re-election, but Mr. Thurnauer did not wish to continue, and the chairman proposed that in his place Mr. George Sutton should be invited to serve on the Committee; this was agreed to, and the remaining members were re-elected. The hon. auditors, Messrs. Price, Waterhouse and Co., were also re-elected, and votes of thanks were accorded to the hon. solicitors, Messrs. Sugden & Hextall; the indefatigable secretary, Mr. F. B. O. Hawes; to the Press, technical and other, for their assistance, and to the I.E.E. and the I.C.E. for accommodation.

Mr. E. Garcke moved a vote of thanks to Mr. Campbell-Swinton for his conduct of the meeting, and expressed the hope that his appeal would be widely read and his generous example followed. He would do all that he could to assist in securing the £10,000. The meeting then terminated.

WAR ITEMS.

Exports to China.—Further names of bodies and persons in China and Siam to whom exports may be consigned appear in the *London Gazette* for April 17th.

Trading with the Enemy.—The "London Gazette" for April 13th contains further lists of bodies and persons in the following countries with whom trading is prohibited:—Argentina, Bolivia, Brazil, Chile, Liberia, Netherlands, Norway, Persia, Spain, &c.

Exemption Applications.—At Dover, the borough electrical engineer applied for exemption for his chief clerk, A. D. Axford (25), who has been placed, after being passed for general service, in Class C 2 by the Special Medical Board. Four months were conceded.

Before the Stroud (Glos.) Rural Tribunal, Messrs. Edwards and Armstrong, electrical engineers, of Cainscross, appealed for 18 men, all of whom are in charge of electrical stations in different parts of the country, most of which supply power to munition works. The Military Representative (Lieutenant Wood) said that the firm had given every possible assistance to the military authorities. At the outbreak of war they had 65 men in their employ, and they had been willing for 50 to go; that, he thought, was almost a record. Obviously, it was impossible to take all the men from this important work, and some he was prepared to pass until suitable substitutes could be obtained. The decisions were that three of the men should join up at once, and the others were put back for the provision of substitutes.

The West Kent Appeal Court, on April 5th, considered a military appeal against conditional exemption held by six employés of the Chatham & District Light Railways Co. Appeals in respect of a storekeeper (29) and a driver (29) were allowed, and the others, relating to a clerk (31), an overhead lineman (25), and two motormen (both 29), were dismissed.

Before the Warwickshire Appeal Court, the Military appealed against exemption granted at Warwick to T. W. Mumford (36, in Class B 1), inspector and driver on the Warwick tramways. Two months, subject to substitution in the meantime, were granted.

At Horsham, exemption was sought by the electrical engineer to the U.D.C. for a junior assistant, aged 19, until a woman could be trained to take his place. Exemption was given until the end of May.

At Hastings, a review was made for conditional exemption held by a night clerk (B 1), the chief clerk and cashier (A 1), a fitter's mate (A 1), a coach maker (C 2), and a petrol car lighting worker (B 1), employed by the tramway company. The certificates of the night clerk and fitter's mate were cancelled, and the other cases were referred to a conference between the Town Clerk, the Military Representative, and the company's representative.

Before the Somerset Appeal Court, the Military appealed against exemption held by W. P. Short (28, in Class B 1), managing clerk and spare switchboard attendant at the Taunton Corporation electricity works. The electrical engi-

neer (Mr. A. J. Howard) said that a man over military age had been tried, but he was of no use. The borough accountant informed the Tribunal that he had no one whom he could transfer to replace Short, who was the connecting link between his office and the electricity department. The application was dismissed, but Mr. Howard was informed that the Tribunal would require good evidence that efforts had been made to replace Short if he was required after July 6th.

At Aberystwyth, Mr. Perkins, manager of the Electric Light Co., appealed for R. J. Jones (37), electrician. He entered the Army last July, but was sent back medically unfit. On going before the Medical Board again last September he was put in Class C 2. Mr. Perkins said that, as far as he knew, Jones was the only man working in the town at present as an electrician. Conditional exemption was conceded.

At Maidstone, Mr. Oswald Jones, electrical engineer, appealed for W. H. Brown (36), passed for general service. Mr. Jones stated that Brown was a skilled engineer, and had for some time been engaged on important work. The Advisory Committee recommended that conditional exemption previously granted should be withdrawn, and this was acted upon, and three months allowed. Mr. Jones also appealed for E. Wicks (28, general service), electrical engineer and armature winder, who, besides other work, maintains the electrical machinery at three important mills. The same decision as in the other case was given.

At Coventry, a review was made of the cases of eight employés of Messrs. Van Raden & Co., electrical storage battery manufacturers, who held conditional exemption. It was stated that all the men appealed for were in certified occupations, and that, owing to the nature of the trade, boys and women could not be employed. Each was given two months' exemption.

At the South Yorkshire Appeals Tribunal, the Military Representative appealed against the exemption of two Doncaster tram drivers and a car-shed foreman. The Town Clerk appeared for the Corporation, and did not oppose in the case of the drivers, but put in a strong plea for the shed foreman, and in this case the military appeal was disallowed.

The South Yorkshire Appeal Tribunal considered an appeal by the Military Representative against exemptions of three employés of the Mexborough & Swinton Tramways Co. The company's representative said they were shutting down their Conisboro' section, and had been forced to run a general half-hour service instead of one of ten minutes. If more men were taken the company would have to approach the Board of Trade with an intimation that they could accept no responsibility for whatever might arise. The Tribunal allowed the Military appeal in each case, but one of the men was given grace to May 31st.

At the Hull Tribunal, it was submitted that a tramway motorman, married, 37 years of age, was in a certified occupation. The age limit, it was stated, had been raised two years, but was now only 27. The man had been classified C 1, and there was a great shortage of drivers. Capt. Chapman: There are no women drivers?—No, women cannot handle the Hull cars. Capt. Chapman: I have seen women drivers elsewhere.—I understand the hand brake is the difficulty on the Hull cars. Capt. Chapman: I think that would present no difficulty to a woman if a C 1 man can work it. Conditional exemption was allowed.

BUSINESS NOTES.

Manufacture of Telegraph Apparatus in Spain.—It is announced from Madrid that, owing to the difficulty of obtaining telegraph apparatus from abroad owing to the war, the manufacture of Hughes apparatus has lately been taken up on a small scale, but with good results, in the workshops of the Director-General of Communications. It is also announced that under the ægis of a Bilbao syndicate a new company has lately been formed with the title La Compania Iberica de Telecomunicacion, to establish works in Madrid (18 Paseo del Rey) for the manufacture of telephone and telegraph apparatus both for the ordinary and wireless systems. It is added that the new undertaking is also interested in a project for the establishment of a system of wireless telephonic communication throughout Spain.

Dissolutions and Liquidations.—Anchor Electric Co., Ltd.—A meeting is to be held on May 18th, at 5, Lincoln's Inn Fields, W.C., to hear an account of the winding up from the liquidator, Mr. T. T. Rankin.

Miller Anti-Friction Metal Co., Ltd.—A meeting is called for May 22nd, at 3, Gore Street, Manchester, to hear an account of the winding up from the liquidator, Mr. A. Hennings.

Bynoe Low-Pressure Superheater System, Ltd.—This company is winding up voluntarily, with Mr. F. Morse, 1 and 2, Great Winchester Street, E.C., as liquidator.

Low-Pressure Superheating, Ltd.—This company is winding up voluntarily, with Mr. F. Morse, as above, as liquidator.

Trade Announcement.—The L.P.S. Electrical Co. has removed to 14, Howick Place, Westminster, S.W.

Catalogues and Lists.—Cambridge Scientific Instrument Co., Ltd., Cambridge.—Three illustrated lists as follows:—No. 134, describing the Cambridge measuring microscope for workshop use; No. 191, dealing with the Cambridge thermo-couple potentiometer; and No. 912, relating to the H. & M. recording and index thermometers.

Spray Engineering Co., 93, Federal Street, Boston, U.S.A.—Bulletin, No. 501, illustrating and describing in condensed form their Spraco system for cooling condensing water, for washing and cooling electrical machinery, and other Spraco developments.

British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 3,265 (eight pages), giving illustrated particulars, weights, dimensions, &c., of motor-control panels for A.C. circuits.

Messrs. Graham & Latham, Ltd., 104, Victoria Street, London, S.W.—Illustrated list (No. 3) of signalling instruction instruments, showing some developments in signalling apparatus. Copies will be sent on application.

"Z" Electric Lamp Manufacturing Co., Ltd., Southfields, S.W. 18.—Card giving prices of special stocks of electrical accessories.

Holophane Illumination Calculator.—An ingenious device under this title has come to hand from Messrs. Holophane, Ltd., of 12, Carteret Street, S.W. It consists of a three-page folder, strongly bound, and fitted with a revolving disk calculator, which takes into account foot candles, lumens, area of space illuminated, height above working plane or street surface, and the type of Holophane prismatic glass refractor employed. Now that illuminating engineering has been brought to so advanced a stage of scientific development, the calculations involved are somewhat complex and intricate, and the advent of this time-saving device should be cordially welcomed by engineers and contractors. Full instructions for the use of the calculator are provided, together with tables showing the relation of lumens to the wattage of lamps, foot-candle intensities recommended for a large variety of cases, the different types of Holophane glassware, and definitions, all most conveniently arranged. It is published at 2s. 6d., and should prove extremely useful.

For Sale.—The Borough of Salford Electricity Department invites offers for the purchase and removal of a Desrumaux type water-softening and filtering plant, and two Mather & Platt pressure filters. For particulars, see our advertisement pages to-day.

Book Notice.—"Scientific Papers of the Bureau of Standards." No. 297, "A Study of Electromagnet Moving Coil-Galvanometers for Use in Alternating-Current Measurements." Washington: Government Printing Office.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The Electricity Committee having considered a report made by Mr. Neville Applebee, the borough electrical engineer, on the recent conference on the linking-up of electrical undertakings in Lancashire and Cheshire, has resolved to take no action in the matter at present.

The Electricity Committee has decided that a minimum charge of 7s. 6d. per quarter be made to all consumers of electricity, and that all motor rentals be increased by 25 per cent., and the charges for delivery and fixing doubled, and that increased charges be made for sundries.

Australia.—The engineer-in-chief of the Sydney Board of Water Supply and Sewerage has recommended that £2,370 be expended in providing an electrical pumping plant, with transmission line, &c., to amplify the power at No. 2, Upper Cordeaux dam in connection with the South Coast towns' supply.

In connection with the Order in Council granted by the Queensland Government to Mr. E. J. Redmond, of Bundaberg, for the installation of an electric lighting and power plant in the town of Gayndah, an extension of time from two to three years has been granted.

A similar concession has been approved in the case of the installation proposed for Dalby.

Barnes.—The electrical engineer has submitted a report on the question of obtaining a bulk supply of electricity from the London and South-Western Railway Co. The engineer also reports having considered the question of installing furnaces suitable for dealing with coke breeze fuel, and finds that some little economy could be effected by this class of fuel provided the relative values remained constant. The cost of equipping a pair of small boilers would be approximately £150, and if the guarantees were sustained there is little doubt that the cost of installing would be repaid on the economy effected in a short period. The Committee recommended that one boiler should be equipped at first, which, if proving satisfactory, the work on the other boiler should then be carried out. The recommendation was approved.

Birmingham.—The annual report of the Birmingham, Tame and Rea District Drainage Board mentions that, in connection with a proposed additional supply of energy, it had been decided to install step-up transformers, with a view to transmitting at a higher pressure, in preference to increasing the copper section of the lines. The alterations would be carried out without interfering with the work of the Board, which is entirely dependent on electric power.

Burton-on-Trent.—Loan Refused.—Regarding the application for a loan of £25,000 for the electricity undertaking, the L.G.B. has informed the T.C. that as the proposed expenditure was not required for national purposes, it did not see its way to sanction a loan at the present time.

Farnworth.—At a meeting of the Council held last week, it was decided, after a long discussion, to restart the destructor works.

Kilmarnock.—New Plant.—The Corporation Electricity Committee has accepted offers for plant in connection with extensions, at an approximate cost of £46,000.

London.—Poplar.—The Electricity Committee has had under consideration the urgent necessity for extending the generating plant to meet next winter's demand. In view of the fact that the cost of extensions at the present time would exceed pre-war cost by at least 50 per cent., negotiations have proceeded with the L.C.C. for linking-up with the Greenwich tramway generating station, and, failing agreement with the L.C.C., the Committee has under consideration alternative schemes submitted by the engineer. Whether interchange of supply with the L.C.C., or the installation of a new generating set be adopted, the erection and equipment of a new sub-station will be necessary, and the engineer has submitted the following estimates:—Erection of new sub-station, £3,000; cable, ducts, and two E.H.T. feeders, £9,581; two 1,000-kw. converters, switchgear, &c., £9,162; mains, £7,200; total, £29,015. The Committee recommends the approval of these extensions.

Lewisham.—The Guardians have received a letter from the South Metropolitan Electric Light and Power Co., Ltd., making application for a further increase in the rate paid by the Guardians for electric current. The Board decided that, during the continuance of the war, a further increase of 5 per cent. be allowed.

Londonderry.—Negotiations have been taking place between the T.C. and North of Ireland Shipbuilding Co. in reference to the terms for a future supply to the shipyard, so far without success. It was explained that the question involved the installation of a new plant, at a cost of £26,000, and the shipyard would be the only consumers. There was a difference of opinion as to the estimate of running costs in particular, and it was therefore agreed to appoint an expert to go into the question of tariff, &c., and with a view to arriving at some agreement with the firm. A small Consultative Committee was also appointed.

A L.G.B. inquiry was held last week by Mr. P. C. Cowan, chief engineering inspector, on the application of the Corporation to borrow £35,500 for the extension of the electric lighting system to the garden suburb, which is being erected for the accommodation of shipyard workers, and for the supply to the yard.—*Belfast News Letter.*

Midhurst.—The B. of T. has extended the Midhurst and District Electric Lighting Order, 1914, for one year.

Montrose.—Public Lighting.—Under a new agreement between the T.C. and the Electric Lighting Co. for the public lighting of the town, the charge per annum will be £611, against £830 under the previous contract, for full-time lighting, and £286, against £575, under the restricted lighting.

Pembroke (Dublin).—Street Lighting.—The Urban Council has decided on a scale of public electric lighting varying from 2½ to 4 hours nightly up to September 21st, instead of the total prohibition of light previously decided upon.

Richmond-on-Thames.—The Richmond (Surrey) Electric Light and Power Co., Ltd., asked the T.C. that the provisions of the agreement of January 20th, 1913, confirmed by the Richmond (Surrey) Electricity Supply Act, 1913, as to the price charged for electric current may in the present abnormal conditions be modified, owing to the increased cost of coal, labour, and transport. Negotiations are proceeding with regard to the matter.

Southend-on-Sea.—In a report of the Electric Light and Tramways Committee, it is pointed out that the profits of both undertakings have been considerable during the past five years, and that there is an urgent necessity for additional generating plant.

Southport.—Year's Working.—The annual report of Mr. A. Black, the borough electrical engineer, shows that the number of units supplied to private consumers was 2,059,590, an increase of 100,076; but the units supplied to the Corporation tramways decreased by 10,674. The year's working showed a net profit of £2,682, an increase of £469 on the previous year.

St. Helens.—Loan Sanction.—The Electricity Committee has received the sanction of the L.G.B. to the borrowing of £710 for enlargement of the boiler house, £4,456 for a water-tube boiler, £634 for a mechanical stoker, and £6,200 for mains and switchgear.

The Electricity Committee has decided that the charge for electricity, both for power and lighting, be increased as from April 1st, 1917, by 30 per cent., in lieu of 20 per cent. as at present.

Tasmania.—A hydro-electric scheme is being considered by the town of Scotsdale; the proposal is to add a generator to the waterworks plant on the Brid river, and a report is to be obtained on the scheme.

Wolverhampton.—Proposed Extensions.—The Electricity Committee has reported on the extension of plant necessary to meet the growth in power load, pointing out that early last year it was decided to install a 5,000-kw. plant complete, but that definite applications have come in for much larger supplies, and that one firm alone will require continuous use of the 5,000-kw. plant referred to, which is now being completed. The Committee therefore recommends that, subject to official sanction, a further extension, at an estimated cost of £67,100, be put in hand. This will include a 5,000-kw. turbo-alternator, with boiler plant, cooling towers, pipes, switchgear, &c., also a new boiler-house wing with bunkers, to house the two proposed boilers.

At a monthly meeting of the T.C., on Monday evening, the report was unanimously adopted. The Council also adopted the recommendations of the Electricity Committee to purchase 2,650 yards of land adjoining the electricity works, together with canal basins, retaining walls, &c., from the Birmingham Canal Navigations, and to lay a high-tension cable to a certain works, at an expenditure of £2,200.

Electric Vehicles.—Three electric vehicles are being purchased by the Electricity Committee, two of 3½ tons capacity at £855 each, from Messrs. Mossay, and one, also of 3½ tons capacity, for £1,220, from the General Vehicle Co.

TRAMWAY and RAILWAY NOTES.

Australia.—In view of the abnormal conditions prevailing owing to the war, and the difficulty experienced in securing material, the Minister of Public Works has decided to recommend the Cabinet to agree to the request of the South Melbourne City Council to extend the time for the completion of the electric tramway line from Patterson Street to Princes Bridge for a further period of three years. The line should have been completed by November this year.—*Melbourne Age.*

Dartford.—Messrs. Balfour, Beatty & Co., Ltd., have applied to the B. of T. for an extension of time until August 18th, 1919, for the completion of the tramways authorised by the Order of 1911.

Huddersfield.—The bad weather of the Easter holiday period resulted in a decrease of £577 in the local tramway receipts for the five days of the holiday, the total being £2,862, as against £3,439 last year.

Ilkeston.—Tramway Purchase.—The Derbyshire C.C. has decided to ask for leave to present an objection against a Bill promoted by the Notts and Derbyshire Tramway Co. for power to purchase the tramways belonging to the Ilkeston Corporation, and any other tramways that can be worked in connection with any of the company's undertakings.

Lancashire.—Female Employes and Bonus.—Tramway working costs will be increased as the result of the award made by the Committee on Production in the recent application by female employés on 14 Corporation and company tramway systems in Lancashire and Cheshire. The request was for a war bonus of 6s. 6d. per week, and the Committee has awarded 3s. 6d. per week to those over 18 years of age, and 2s. a week to those under that age. The award dates back to the first full pay week after March 12th, and between 4,000 and 5,000 women and girls are affected. The districts concerned are Manchester, Salford, Oldham, Rochdale, Accrington, Ashton-under-Lyne, Birkenhead, Bolton, Bury, Stockport, Warrington, Wigan, Hyde, Preston, Mossley, Stalybridge, and Dukinfield. Previous advances since the war are included in the amount, and in Manchester and Salford the award will mean an increase of 1s. 6d. for women and 1s. for girls.

Leeds and Bradford.—Despite the lack of railway facilities, the Easter tramway receipts at Leeds and Bradford—especially Bradford—have fallen off this year, the reason being the wintry weather. The total of the Leeds receipts was £6,688, as against £6,702 last year for the four days. The Bradford receipts dropped from £6,953 to £6,097 for five days.

Walsall.—The manager of the tramways has reported as to experiments he has made with a trolley reverser, and has been authorised to fix the apparatus at the termini.

TELEGRAPH and TELEPHONE NOTES.

New York Telephones.—The report of the New York Telephone Co. for 1916 shows a gross revenue of $57,005,565, a gain of $7,376,019 over the preceding year. The net income amounted to $15,002,260, against $11,250,700, to which was added $5,014,168 derived from investments and $590,826 miscellaneous earnings. After dividends were paid a balance of $7,265,341 remained, a total $3,463,000 larger than in 1915.—*T. and T. Age.*

The Bell System.—The annual report of the American Telephone and Telegraph Co. and associated companies shows that, in round numbers, the total operating revenues of the Bell system were $264,600,000, an increase of $30,151,000 over the year before.

Depreciation and maintenance consumed $84,556,000, an increase of $8,797,000; traffic expenses consumed $53,749,000, an increase of $7,963,000; commercial expenses, $25,699,000, an increase of $2,116,000; general and miscellaneous expenses, $11,902,000, an increase of $853,000; taxes assignable to operations, $14,916,000, an increase of $1,915,000.

The "total gross income" was $79,353,000, an increase of $9,787,000 over 1915. Out of this $22,114,000 was paid for interest, rents, &c., leaving $35,160,000 for dividends and over $22,000,000 to be carried into surplus. Approximately $6,000,000 was paid to the employés as additional compensation to cover abnormal working conditions and living expenses of the year.

The Employés' Benefit Funds aggregated at the end of the year $9,151,000, and in the last four years the expenditures from these funds have amounted to $5,611,016. Pensions are paid to 284 former employés. Benefits were paid last year in 18,760 cases. There were 10,646 accident cases, of which comparatively few were serious, and the payments on these were $557,979. Death benefits of $157,077 were paid to the dependent relatives of 182 employés.

Employés of the Bell system who were in military service on the Mexican border were allowed full pay for the first three months of their absence, and thereafter full pay less the amount they received from the Government. These allowances aggregated $284,194.

The statement of the American Telephone and Telegraph Co. shows that its expenditures are only for the maintenance of the central administration of the whole Bell system, and that its receipts are from its investments in its associated companies, the payments of these companies towards the maintenance and expenses of the central administration, and the earnings of the long-distance lines.

The net earnings of the American Telephone and Telegraph Co. for the year were $44,743,376, which is $3,625,889 more than for the previous year. The interest charges were $6,730,099, and the dividends, at the regular rate of 8 per cent. per annum, were $31,122,187. Of the resulting balance there was carried to reserves $2,500,000, and to surplus $4,391,090. The capital stock of the company outstanding was $395,603,600, and the number of stockholders (of whom the majority are women) was 70,555. In addition, there are 43,000 employés of the Bell system who have purchased stock and are paying for it out of their wages.

An unusually large number of improvements have been introduced in cable, switchboard, sub-station and other apparatus, resulting in economies and advances in service of great public value.

The number of telephone stations on December 31st, 1916, was 9,847,192, an increase during the year of 695,971, of which 577,380 were owned by the Bell companies, and 118,591 were Bell connected stations. The total mileage of wire for exchange and toll service was 19,850,315 miles, an increase of 1,344,770. Fifty-eight per cent. of the wire mileage is underground, and 2,682,910 miles were toll wire. The number of daily telephone connections increased to an average of 29,420,000, or at the rate of 9,789,700,000 a year, which is approximately 100 calls for every man, woman and child in the United States.—*T. and T. Age.*

The Mackay Companies.—The report of the Mackay Companies states that the year 1916 has been a year of extraordinary prosperity in the United States, and the trustees have under consideration the advisability of increasing the dividend upon the common shares from 5 to 6 per cent. per annum. The long-distance telephone business transacted by the Postal Telegraph-Cable Co. has increased greatly during the past year. It is a "by-product," being transmitted over wires which are used at the same time for telegraph purposes. It is remarked that "out of the dark background of the war, the value and stability of the submarine cable property stands out prominently. The service which it is rendering is inestimable. In the prime factors of secrecy, speed, and accuracy it has no rival. Its position is strengthened, rather than weakened, by the results of wireless telegraphy. . . . There is no reason to believe that the wireless can ever render a service as reliable as that of the submarine cables." During the past year a large portion of one of the Commercial Cable Co.'s main cables was renewed in deep water, the expense thereof being paid out of the company's revenue. For the year ending February 1st, 1917, the receipts from investments in other companies were $4,683,265, and the expenses $56,800, the dividends paid on the Mackay Companies' preferred shares being $2,000,000 and on the common shares $2,069,020, leaving a balance of $557,446, which was carried forward. The assets of the companies amounted to $93,293,745.—*T. and T. Age.*

U.S. Wireless.—The radio station built for the United States Navy Department near San Diego, Cal., is now in regular service. The plant is nominally rated at 200 KW., operates on the Poulsen system, and is the most powerful thus far put in service. The aerial is carried by three 600-ft. self-supporting steel towers placed in a triangular position. This is the third in the chain of navy high-powered radio stations, of which Arlington was the first and Darien the second. Pearl Harbour and Cavite are the next two in the progressive development, and these will have apparatus of much higher power than that installed at San Diego. The arcs for Pearl Harbour and Cavite weigh 65 tons each, and are the largest and most powerful pieces of radio apparatus ever built. All of these stations are being constructed by the Federal Telegraph Co. and operated on the Poulsen system.

Tests carried out at the end of January resulted in the maintenance of strong and continuous communication over 12-hour periods between the station of the Marconi Wireless Telegraph Co. of America at Chatham, Mass., and that of the English Marconi Co. at Carnarvon, Wales. The signals received at Chatham from Carnarvon were from three to eight times as strong as those received from any other European station.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—MELBOURNE.—May 23rd. Victorian Railways Department. Twelve months' supply (8,250) of incandescent electric lamps as ordered.*

Dundee.—April 21st. Corporation Electricity Department. Steelwork in floors, &c., and straining screens, guide rails, &c., at No. 2 pump-room at Carolina Port. Schedules, &c., from General Manager and Engineer.

London.—HAMMERSMITH.—April 25th. B.C. Electricity Department. Induced-draught fans, mechanical stokers, boiler feed pump, centrifugal pump and strainer for condenser. See "Official Notices" April 13th.

Manchester.—April 24th. Corporation Tramways Committee. Hard-drawn trolley wire. General Manager.

South Africa.—JOHANNESBURG.—April 30th. Municipal Council. 10,000 traction carbon brushes, 63·5 × 35 × 12·5 mm.* May 21st. Municipal Council. Gear wheels for tramcars. Contract No. 241.*

[* Specifications may be seen at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C.]

CLOSED.

Bedford.—T.C. Accepted tenders :—

B.T.H. Co., Ltd.—Switchgear, £1,650.
J. P. Hall & Son, Ltd.—Feed pumps, £340.
T. & T. Vicars.—Coal-handling plant, £718.
Robert Jenkings.—Stores buildings (electricity works), £759.

Chester.—Board of Guardians. Messrs. F. J. Jones and Co., at £587, for equipping the House with electric light.

Heckmondwike.—Electricity Committee. 1,000 tons of Askern slack coal, Messrs. Armitage & Co.

London.—STOKE NEWINGTON.—The Highways and Sewers Committee recommends the acceptance of the tender of Mr. C. Spreadborough for the installation of electric power plant for chaff-cutting and corn-crushing at the Council's stables (exclusive of the supply of the machines).

POPLAR.—Electricity Committee. Tender recommended for a 1,000-KW. rotary converter, at £3,074, G.E. Co.

Wolverhampton.—T.C. Accepted tenders :—

Gibbons, Dudley.—Platform, handrailing, stairway and ladder to form the operating floor for the new turbo-alternator, £220.
Chloride Co.—Ironclad Exide battery for the delivery van, £142.
George Waller & Son, Stroud.—Special automatic self-cleaning water screening plant, £269.
Mossay & Co., Ltd.—Two 3½-ton electric vehicles, £855 each.
General Vehicle Co.—One 3½-ton electric vehicle, £1,220.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, April 20th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting. Presidential address.

Junior Institution of Engineers.—Monday, April 23rd. At 7.30 p.m. At 39, Victoria Street, S.W. Honorary Members' Lecture, on "Some Applications of Radio Activity," by Prof. H. T. Davidge.
Friday, April 20th. Paper on "Gas Turbines," by Mr. S. E. Hutson.
Saturday, April 21st. At 6.30 p.m. At the Holborn Restaurant. Third Bohemian concert, in aid of St. Dunstan's Hostel for Blinded Soldiers.
(Midland Section).—Friday, April 20th. At the Imperial Hotel, Temple Street, Birmingham. Paper on "Water Softening," by Mr. O'Callaghan.

Royal Institution of Great Britain.—Thursday, April 26th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Industrial Finance After the War—its Financial Needs: How they can best be met" (Lecture II).

Institution of Electrical Engineers.—Thursday, April 26th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "High-tension Overhead Transmission Lines," by Mr. G. V. Twiss.
(Birmingham Local Section).—Wednesday, April 25th. At 7 p.m. At the University, Edmund Street. Paper on "High-tension Overhead Transmission Lines," by Mr. G. V. Twiss.
(Yorkshire Local Section).—Wednesday, April 25th. At 7 p.m. At the Philosophical Hall, Leeds. Discussion on "Wayleaves," with introductory paper by Mr. C. Vernier. Annual general meeting.

Belfast Association of Engineers.—Thursday, April 26th. At 7.45 p.m. At the Municipal Technical College. Annual general meeting.

NOTES.

A New Source of Platinum.—According to the *Bulletin* of the Siberian Engineers' Society, on the platinum fields of the Nizhni-Tagilsk Mining Circuit, the mining engineer, V. N. Tchorzhevsky, has begun the first experiments in the world on the extraction of platinum from dunite. The experiment promises to be exceedingly interesting. The platiniferous nature of dunite has long ago been observed, and the presence of the metal is apparently connected with the existence in the rock of chrome iron ore, on the abundance of which the greater or lesser content of platinum in the whole dunitic mass depends. All this was known before, but was rather of scientific interest; and it is only now that the investigation of the dunites for platinum on a wide scale is being undertaken, in order to prepare a plan for utilising the immense reserves of dunitic rocks which in the Nizhni-Tagil district alone occupy an area of 11·7 sq. miles. The method of extraction adopted is the simple grinding under runners of the rock, and the collection of the chromitic slack, and then a fresh grinding of the latter in order to leach the pure metal finally from it. The chromitic slack remaining after washing the platinum sands being scrupulously cleared of all visible platinum, yielded with an experimental grinding by runners, in the month of March, when it was still impossible to deliver dunites to the factory, over 200 oz. of metal out of 9,720 lb. The grey slack, which consists chiefly of undecomposed dunite obtained from the dredges when washing platinum, yielded 2·6 zolotniks of metal from 3,600 lb.

Galvanometers for A.C. Measurements.—A new publication of the Bureau of Standards (Scientific Paper No. 297), entitled "A Study of Electromagnet Moving-Coil Galvanometers for Use in Alternating-Current Measurements," gives the results of an investigation of alternating-current galvanometers of the separately excited, iron-cored, electrodynamometer type. It is shown how the operating constants (the sensitivity, period, and damping) depend upon the construction constants, upon the excitation, and upon the electrical constants of the moving-coil circuit. These relations are given in such a manner as to facilitate the design of instruments to have definite operating constants under the conditions of use. Four instruments with sensitivities up to 15 mm. per microvolt are described, and the results of tests with frequencies up to 2,100 cycles per second are given. Those interested may obtain a copy by addressing a request to the Bureau.

The Optophone in Operation.—At the Selenium Laboratory, on March 28th, Dr. Fournier d'Albe gave a demonstration of optophone reading before a small company. The demonstration was interesting, as being the first which has shown the reading of small type by ear. As a test passage, a leading article from the *Times* was chosen. The inventor was blindfolded, and given the article, which he inserted in the optophone, and he then slowly but accurately began to spell out the sentences. The reading was achieved without an error. The speed attained was not more than three words a minute, but Dr. Fournier d'Albe believes that by practice a considerably higher speed can be attained. The line-changing mechanism places an outside limit of 25 words on the reader's progress. To use the optophone students have to learn its alphabet, which is a kind of musical adaptation of the Morse alphabet. There are sound dots and dashes, but these are combined with a range of musical notes falling within the compass of an octave. The sounds are conveyed to the ear by a receiver.—*The Times.*

Ministry of Munitions and Tramway Materials.—According to the *Journal* of the Tramways and Light Railways Association, the following important Instruction has been issued by the Priority Department, dated April, 1917:—

"I am directed to inform you that in order to enable the British tramway companies (the maintenance of whose service is of importance from the point of view of the production of munitions of war) to replace orders for steel and copper required *strictly for maintenance purposes only*, without referring each case to the Ministry of Munitions, it has been decided to allocate a priority reference number to each company. This will entitle such orders to be dealt with under Priority Instruction 5. With regard to steel, this Instruction does not cover requirements for new plant or renewals, nor does it include heavy repairs to track or buildings, but is intended for a limited supply of rolled plates, sheets, tires, axles, blooms, billets, forgings, and castings. It should be noted that high-speed steel, crucible tool steel, manganese steel, and malleable castings cannot be obtained except on special application to this department, and the permit number and reference of this Instruction must not be used for orders of that class. The Instruction with regard to copper, brass, and copper alloys is intended to cover only the most urgent repairs essential to maintain your existing plant, and no request for more than 1 cwt. of copper can be applied for under this permit. Copper pipes of all kinds are excluded.

"It is a condition that every three months detailed returns of the total quantity of copper, brass, and copper alloys obtained under this permit be submitted to this department.

"The priority number assigned to your tramway company is Sub. , which must be quoted on each individual order you place with your manufacturers, as follows:—

"Ministry of Munitions' Permit Number and Priority Classification Sub.

"Signed, &c.,

"For Deputy Controller,

"Priority Department."

Inquiry.—Makers of the "Limpet" plug are asked for.

Technical Education in Australia.—We are indebted to Mr. H. R. Harper, city electrical engineer of Melbourne, for particulars of a scheme of technical training which has been adopted by the City Council in connection with its electricity supply department, with a view to raising the standard of efficiency in the technical branch of the service. The scheme comprises a system of apprenticeship, with provision for technical training, and a system of scholarships whereby the most promising of the junior engineering staff may be able to gain valuable experience in one or other of the workshops of the best British electrical manufacturers.

It is proposed in future to restrict entrance into the department to boys who have completed a course at one of the Junior Technical Schools, which are really Continuation Schools, having special courses of study to fit boys for the trades to which they are to be apprenticed.

The number of apprentices required each year in the electricity supply department will be about eight. The period of apprenticeship will be five years, and a condition will be that during the first three years apprentices shall attend evening classes, the Council paying the fees.

The apprentice who each year of the three years' period of tuition may be adjudged by the city electrical engineer first in order of merit, will be awarded a prize ranging from £5 in the first year to £10 in the third. The cost to the Council in fees and prizes under this scheme will amount to £120 per annum, which amount the Committee considers will be amply repaid by the attracting to the service of a higher grade of youths who ultimately will become more efficient workmen.

In considering applications for employment in the department as junior engineering assistants, a great deal of weight is attached to the claims of those who have had training abroad. There are, however, few local men who can afford to obtain that training. It is therefore proposed that each year the Council shall send one of these juniors to Great Britain for two years' experience in approved electrical manufacturing works. The members of the staff to receive this special training will be chosen as a result of an examination of their technical knowledge and of their progress in the department.

It is recommended that the Council provide the successful candidate with the sum of £50 to cover his return fare, and an allowance of £1 per week during his two years' absence to supplement his earnings while at home.

Each successful candidate would be required to enter into an agreement with the Council to return to Melbourne at the end of the term of two years, the Council undertaking to employ him as engineering assistant for the term of from one to three years, at the salary ruling for such a position in the department. The cost of this system of travelling scholarships would amount to £150 per annum. The Committee feels that, as in the case of apprentices, this expenditure will also be fully justified by ensuring amongst the staff a growing number of officers who will have had the benefit of this valuable training. Assurances have already been received from some well-known works that they will be glad to receive young Australians of high calibre and give them every opportunity of gaining an insight into the latest developments in the design and construction of electrical plant. The object of the Committee in submitting these proposals is to offer such facilities as will attract to the Council's service the best of the young men available in the community.

It is certainly an admirable and enlightened scheme, and should prove highly beneficial to the electricity department, as well as to the boys and men who are fortunate and worthy enough to receive these privileges.

Fatalities.—At an inquest at Dukinfield on John Nash, labourer, at the Hartshead Chemical Works, who died as the result of an electric shock whilst handling a lamp, a witness stated that the firm had not an electrician; they had been to the Labour Exchange, and the engineer had tried to get one, but could not, and they had to use the labour available. Mr. R. Blackmore, engineer to Stalybridge, Hyde, Mossley, and Dukinfield Joint Electricity Board, thought the lampholder had been brought in contact with one of the supply wires. A verdict of "Accidental death" was returned.

No-Lighting Rate.—The argument that it was ridiculous to have to pay a lighting rate, when owing to the war restrictions there had been no lights, was advanced by Marie Elvin, of Ainsworth, who was summoned to the Bury County Police Court last week for non-payment of a lighting rate of 15s. She said there had been no lights at all for 18 months, the bulbs being removed. It was stated that the Parish Council was under an agreement with the power company, and the greater part of the amount was for the equipment, and only a small amount for light. The rate had been reduced by half. An order for payment was made.

A German in Shanghai Power Station.—The *Times* Shanghai correspondent states that early in April a German ex-Marine, formerly at the Legation in Pekin, was caught inside the Shanghai electric power station in suspicious circumstances. (Was he repairing the A.E.G. turbo plant?) He was being tried in the mixed Court, when the Dutch Consul-General claimed jurisdiction, and the man was handed over to him, and ultimately acquitted after a secret trial in German, held in a private German house, two German Consulate officials assisting. The correspondent says that much public indignation has been aroused.

Electrolytic Zinc Smelters.—Smelters are being erected near Hobart, Tasmania, for the production of metallic zinc by the electrolytic process. It is hoped that metallic zinc will be produced by the beginning of August next. By the time the whole of the works are completed, from £750,000 to £1,000,000 will have been spent upon them.—*Board of Trade Journal.*

German Substitutes for Copper in Electrical Work.—The *Revue Générale de l'Electricité* gives a summary of a lecture given at Frankfort dealing with substitutes which are being or could be used in Germany in place of copper. As long ago as the end of 1914 the Germans replaced many of their copper conductors with aluminium, zinc, iron, &c. In many cases zinc is too brittle, and it is affected by temperature variations. Although these disadvantages are got over to a great extent by using pure metal, the low mechanical strength and low melting point are serious obstacles in the way of its adoption. Cables have been manufactured with steel or iron cores and stranded with zinc wire, so that these "mixed" conductors have both the mechanical strength of iron and the high conductivity of zinc. Bus-bars are made in long lengths of zinc. With certain grades of zinc it has been possible to get cables which, when laid, have the same qualities as copper conductors. For instance, a wire 1 to 2 mm. in diameter can be twisted 20 times round a rod 1 mm. in diameter. When zinc conductors are laid direct in the ground they should be covered with impregnated paper and a lead sheath.

Iron has been tried, successfully, especially for railway and tramway conductors. On the Berlin-Lichterfelde line the copper rail bonds have been replaced by covering the ends of the rails with a layer of zinc on the Schoop system.

For smaller work zinc and iron have competitors in aluminium, magnesium, and alloys such as electron (10 per cent. aluminium, 91 per cent. magnesium), which is non-magnetic and easy to machine, magnalium, and duralumin.

Lamp sockets have been made of cast-iron, and liquid starting rheostats and lamp fittings of iron, zinc, or wood. In measuring instruments copper disks are replaced by aluminium, and the magnets, instead of being of tungsten-steel, are made of chrome-steel, which is only slightly less magnetic.

Zinc has been tried for winding generators and transformers, and with partial success; A.C. motors wound with zinc wire have an output varying from 40 to 60 per cent. of that of copper-wound machines. With transformers, zinc decreases the output by about 27 per cent.

For lubrication a mixture of oil and graphite has been suggested in place of oil, as have also water and dextrin, and even solutions of potash.

Ceylon graphite, used almost exclusively before the war for carbon brushes, has been replaced by Bavarian graphite, which, suitably treated, gives a 97 per cent. product, which is sufficient in practice.

Electric v. Oil Power on Farms.—An agricultural correspondent in the *Autocar* asks: "Are we right in thinking so much about tractors?" pointing out that there are objections to mechanical ploughs on heavy land, and that the great thing is to keep every heavy implement off the land. He says: "My idea has always been that you ought to have a central electric power station which, with the aid of cable to each field, movable or permanent, would work every implement except, perhaps, a hoe. The dream may be impossible of fulfilment, owing to expense." He goes on to point out that, in addition to ploughing, there are a number of following operations on the land which cannot be performed by the tractor. It is unsuitable for reaping, and in the last damp harvest, the wheels pressed into the land so much that the evil was seen after the ploughing, and will be seen in the crops. There is obviously scope for invention in the matter of cultivating land with as little injury to it as in the case of horse-drawn implements.

The Bakerloo—Watford Railway Extension.—Elsewhere in this issue we publish a short illustrated article on the Bakerloo-L. & N.W. electric train service which was opened to the public on Monday last, and which the technical Press had an opportunity of sampling on the occasion of a trial run during the preceding week. Of the trial run we will only say that the users of this route will enjoy a measure of comfort and celerity far in advance of that usually obtaining under steam operating conditions.

The new service represents the first occasion on which tube rolling stock has been regularly employed on a main line railway; but, owing to the abnormal times, the stock employed is such as could be obtained from the existing tubes lines for temporary use.

For this reason, it will be noted that some modification of the equipment of the motor-cars, which were built for use on the Central London third-rail route, has been necessary, in order to adapt them for use with the insulated return rail employed on the Bakerloo and L. & N.W. routes.

A somewhat novel feature of the route, not mentioned elsewhere, is that the running lines beyond Queen's Park pass through the car-shed, thus rendering such lines available for car storage at night.

The past winter has severely tried electric railways in the open, by reason of the ice skin which forms on the conductor rails during frosty nights, thus preventing the shoes from making the necessary contact with them, and one of our views show the sleet-brush which is being tried on this route, with a view to overcoming the trouble.

Appointment Vacant.—Working electrical engineer (50s.), for the Holmfirth U.D.C. electricity undertaking. See our advertisement pages to-day.

U.S. Car-lighting Association.—Eight of the largest manufacturers in America of electric lighting and engine-starting sets for petrol motor-cars have just joined together in the formation, at Toledo, of the Equipment Association, the object of which is to draw up and work to a standard set of "service" reports and forms for "service station" work. Most of the manufacturers of such apparatus for motor-cars run in connection with their business what is known as a "service department," whose purpose it is to assist users in keeping their appliances in good working order, and it is with the view of working to a uniform plan that the new Association has been organised.

Marine Engine Builders Wanted.—It is announced in the Press that the Shipping Controller would be glad to hear from any engineering firms in the United Kingdom not usually engaged in building marine engines, who would undertake this class of work. They should state their possibilities. Further, the Controller would be glad to know of any schemes for establishing new shipbuilding yards in any parts of the country. Letters should be addressed to the Shipping Controller, St. James's Park, S.W.

A Bonus System at Work.—A telephone operator passed on to a foreman the message: "Tell Fritz S. that his wife has been found dead in bed." On receiving the message, and being told that his work might be dropped right where it was, Fritz replied: "Vot's de use. I don't can do her no goot now, undt, pesides, I vill lose mine bonus!"—*Industrial Management.*

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the March meeting of the Association, a set of rules was discussed, and, after a few amendments had been agreed to, they were unanimously adopted by the Association.

Mr. John Milton gave some particulars concerning a curious case of failure of the high-pressure air delivery, which occurred in a compressor attached to a Diesel engine at High Wycombe. Apparently the trouble was caused by the introduction of a new high-pressure delivery valve, but the actual fault could not be discovered, and it was found necessary to replace the high-pressure delivery valve formerly in use before the air compressor could be got to work again satisfactorily.

Some particulars were given to the meeting concerning a tar oil which was being introduced on the market as suitable for use in Diesel engines.

Mr. R. W. Lyle drew attention to a blast regulator which could be fitted between the compressor and the engine, and which rendered the use of a blast bottle unnecessary.

Royal Society of Arts.—On Wednesday last, Mr. H. M. Thornton read a paper on "The Application of Coal Gas to Industry in War-Time: its National Importance." Prof. W. G. Fearnsides is to deliver two lectures (April 30th and May 7th) on "The National Shortage of Iron Ore Supplies." On May 9th, Prof. W. Ripper will deal with "Works Organisation and Efficiency."

Institution of Electrical Engineers.—At a meeting of the Newcastle Local Section on Monday last, the chairman (Mr. H. W. Clothier) announced with regret that one of their members, Second-Lieut. H. Algar, who joined the Forces about three months ago, had died in hospital. The Committee had had under consideration a report as to the training that was being given to disabled soldiers and sailors at the Cowen Home to fit them to take employment in the electrical industry. The Committee had decided, in accordance with the practice followed since the war began, that there should be no Local Section dinner this year, and suggested to the members that the money which they would in times of peace have paid for the dinner should be, instead, sent to the secretary of the Cowen Home as a subscription; those who felt they were able to subscribe more would give according to their conscience.

Mr. C. Vernier then read his paper on "Wayleaves."

Greenock Electrical Society.—At the annual general meeting, the reports of the secretary and treasurer were adopted, and office-bearers were elected: Hon. president, Mr. H. Ferrier; president, Mr. S. James; vice-presidents, Messrs. D. Angus, G. Macdonald, and W. B. Smith; hon. treasurer, Mr. W. M'Gibbon; hon. secretary, Mr. W. Love.

Decimal Coinage and the Metric System.—At a meeting of merchants of the City of London, on Wednesday last, a resolution was passed to the effect that, in view of the great advantages which would accrue to British commerce with foreign countries from the use of the decimal system, it was desirable that steps should be taken to secure its immediate adoption.

A meeting of the Castle Baynard Ward Club was held, on the same day, to discuss the metric system of weights and measures. Sir Vansittart Bowater, who presided, mentioned that not only had the City made great headway with the adoption of the system in the past few years, but every Chamber of Commerce of which he was aware had passed a resolution in its favour, while many trades and professions had similarly expressed their approval. A resolution was passed to the effect that steps should be taken to secure the immediate adoption of the decimal system, so that it might be in operation at the conclusion of the war.

Prohibited Exports from Countries Abroad.—The Supplement to the *Board of Trade Journal* of April 19th contains a complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius and Ceylon.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters: Balderton Street, Oxford Street, W.

Orders for the Week, by Lieut.-Colonel Clay, V.D., Commanding:—

Monday, April 23rd.—Technical for Platoon No. 9 at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, April 25th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, April 26th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6.30. Signalling Class.

Friday, April 27th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Recruits' Drill, 6.30—8.30.

Saturday, April 28th.—N.C.O.'s Class, 2.45, under Captain Bentley and the Instructor of Musketry.

Sunday, April 29th.—Special work at Bombing School. Parade, Clapham Junction Station (City and S.L. Railway), Tube, 9.45 a.m.

(By order), Macleod Yearsley, *Captain and Adjutant.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. John Senior, acting electrical engineer to the Ilkley U.C., has been appointed engineer and manager, at £250 per annum.

The Wolverhampton T.C. has increased the salary of Mr. C. Bellhouse, boiler-house superintendent at the electricity works, from £180 to £230 per annum.

Mr. H. A. Greaves, assistant mains engineer at the Sheffield electric supply department, was presented with a roll-top desk by his colleagues upon leaving to take up a position with Messrs. T. H. Watson & Co. The presentation was made by Mr. S. E. Fedden.

The Dundee Corporation Electricity Committee has decided that Mr. Bishop, Mr. Lamb, and Mr. Reid receive a bonus of £50 a year for the extra work done while the engineer (Mr. Richardson) was with the Forces. The department has saved £300 on the engineer's salary by his Army pay, so that the bonus will not cost the department anything.

General.—Mr. John C. McLennan, Professor of Physics at the University of Toronto, has accepted a seat on the British Board of Inventions.

Dr. Alexander Graham Bell, inventor of the telephone, was presented with the Civic Forum Medal of Honour for distinguished public service, at a meeting of the Civic Forum, New York, on March 21st.

At Wellingborough Parish Church, on April 12th, the marriage took place of Mr. Hugo Stephens, of Northampton, of the Premier Accumulator Co., and Miss Mary Elizabeth Pendered. From the employés of the Premier Accumulator Co., Mr. Stephens received a silver inkstand and brasses.

At an informal gathering on March 6th, Mr. G. M. Sichel was the recipient of a chronometer presented by members of the London erection department of the British Westinghouse Electric & Manufacturing Co., Ltd., as a token of their regard and esteem, on the occasion of his leaving to take charge of the erection work in Scotland.

Roll of Honour.—Sergeant Leslie Smith, of the Australian Force, who is reported killed in action, went to Sydney some five years ago to take up an appointment as electrician. He had been three times in hospital. He served his apprenticeship as an electrician with Messrs. Thompson Bros., of Blackburn.

Corporal W. H. Townley, King's Own Scottish Borderers, of Wilmslow, Manchester, who has been killed in action, was formerly engaged as an electrician at Stockport and Wilmslow. At the Battle of Loos he gained the Croix de Guerre of France.

The *Times* reports that Captain Stanley J. Snowden, Middlesex Regiment, reported killed on March 26th, aged 25, was educated at Heddon Court and at Harrow. On leaving Harrow he trained as an electrical engineer at Faraday House, and later obtained an appointment on the L. & N.-W. Railway.

Corporal John McKenzie, Essex Regiment, on the works staff of the Western Electric Co., has fallen in action. Last year he gained the Military Medal.

Second-Lieutenant Arthur Annan Johnston, R.F.A., formerly in the G.O. Department of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., Silvertown, died of wounds on April 16th.

Obituary.—Mr. Robert Young.—The death has occurred of Mr. Robert Young, electrician, of Oldham, at the age of 63.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire Electrical Engineering Co., Ltd.—Equitable charge on Volt Works, Ashton-under-Lyne, dated March 20th, 1917, to secure all moneys due or to become due from company to Union Bank of Manchester.

Cambridge Electric Supply Co., Ltd. (36,457).—Capital, £100,000 in £10 shares. Return dated March 14th, 1917. 9,911 shares taken up; £89,199 paid. Mortgages and charges: £30,000 first mortgage debentures and one debenture with bankers to cover £15,000.

Crampton & Co., Ltd. (109,328).—Registered April 29th, 1910. Capital, £2,500 in £1 shares. Return dated March 22nd, 1917. All shares taken up; £2,500 considered as paid. Mortgages and charges: Nil. Registered office: 73, Queen Victoria Street, E.C.

Cross & Cross, Ltd. (105,754).—Capital, £5,000 in £1 shares. Return dated December 31st, 1916 (filed April 3rd, 1917). All shares taken up; £155 paid; £4,845 considered as paid. Mortgages and charges: £600.

S. Bornett & Co., Ltd. (89,565).—Capital, £2,000 in £1 shares (1,000 pref.). Return dated March 5th, 1917. 757 pref. and 950 ord. shares taken up; £1 per share called up on 757 pref. and (5s. premium) £1 5s. per share on 200 ord.; £1,007 paid; £750 considered as paid on 750 ord. Mortgages and charges: Nil.

City of Buenos Aires Tramway Co. (1904), Ltd. (82,214).—Capital, £1,240,000 in £5 shares. Return dated March 1st, 1917. All shares taken up; £1,240,000 considered as paid. Mortgages and charges: £74,000.

Fred Danks, Ltd. (122,376).—Capital, £30,000 in £1 shares. Return dated March 28th, 1917. All shares taken up; £30,000 paid. Mortgages and charges: Nil.

Dynamic Electrical Co., Ltd. (104,436).—Capital, £100,000 in £1 shares. Return dated December 31st, 1916. Seven shares taken up; £7 paid. Mortgages and charges: Nil.

Crossley Bros., Ltd. (51,970).—Capital, £973,700 in £1 shares (403,390 pref. and 570,310 ord.). Return dated March 13th, 1917. All shares taken up; £278,200 paid on 278,200 ord; £695,500 considered as paid on 125,190 pref. and 570,310 ord. Mortgages and charges: Nil.

Electrical Industries Development Co., Ltd. (89,461).—Capital, £25,000 in £1 shares (20,000 pref. and 5,000 ord.). Return dated December 31st, 1916. 9,007 pref. and 5,000 ord. shares taken up; £4,007 paid on 4,007 ord.; £10,000 considered as paid on 5,000 pref. and 5,000 ord. Mortgages and charges: Nil.

W. E. Dove & Co., Ltd. (72,630).—Capital, £3,500 in £10 shares. Return dated March 12th, 1917. 320 shares taken up; £2,000 paid; £1,200 considered as paid. Mortgages and charges: £800.

Charing Cross, West End & City Electricity Supply Co., Ltd. (29,122).—Capital, £2,100,000 in 130,000 pref., 130,000 ord., 80,000 City Undertaking pref., and 80,000 City Undertaking ord. shares of £5 each. Return dated March 29th, 1917. 80,000 pref., 80,000 ord., 80,000 City Undertaking pref., and 70,000 City Undertaking ord. shares taken up; £1,200,000 paid on the pref., ord., and City Undertaking pref.; £350,000 considered as paid on the City Undertaking ord. Mortgages and charges: £1,087,178.

CITY NOTES.

Swiss Electrical Companies.

The directors of the *Accumulatoren Fabrik Oerlikon* recommend the payment for 1916 of a dividend at the rate of 20 per cent., as in 1915, and propose an increase in the share capital from £48,000 to £66,000.

The directors of the *Gotthardwerke A.G. fur Elektrotechnische Industrie, of Bodio*, in which German as well as Swiss firms are interested, recommend the payment of a dividend of 15 per cent. for 1916, as contrasted with 10 per cent. in the preceding year.

The Elektrizitats Gesellschaft Alioth, of Basle, which belongs to the Brown-Boveri group, and is now solely an investment company, reports gross profits of £22,000 for 1916, as contrasted with £19,000 in the preceding year. The net profits are £13,800, as in 1915, and the dividend on the ordinary share capital of £240,000 is at the rate of 5 per cent., as in the previous year.

The Schweizerische Ges. fur Elektrische Industrie, of Basle, which is an investment company having interests also in undertakings situated in belligerent countries, reports gross profits of £124,000 for 1916, as contrasted with £173,000 in the preceding year, on an ordinary share capital of £800,000. After defraying the interest on the loan capital of £2,400,000, the balance is absorbed by general expenses and taxes, whereas in 1915 the net profits of £49,000 permitted of the distribution of a dividend at the rate of 5 per cent.

The accounts of the *Aluminium Industrie, A.G., of Neuhausen*, indicate net profits, including the balance brought forward, amounting to £682,000 for 1916, as compared with £379,000 in the preceding year. It is intended to pay a dividend at the rate of 20 per cent. on the paid-up capital of £1,050,000, as compared with the same rate on £840,000 in 1915, and to transfer £346,000 to the fund for fully paying up the shares, as against £140,000 devoted to this purpose in 1915, there thus remaining to be made only a further appropriation of £4,000 in order to pay the shares up in full.

Willans and Robinson, Ltd.

The accounts for 1916 show, after payment of debenture interest, provision for depreciation of plant and machinery, and re-valuation of stocks, and allowances to employés on active service, a net profit of £20,090. As in the previous year, special provision has been made on account of new outlays, and the exceptional wear and tear arising from conditions connected with war output. After paying the dividends on "A" and "B" preference stocks, and annual interest on funding certificates outstanding, a dividend of 10 per cent. is recommended on the ordinary shares, leaving £12,140, of which £10,463 is to be put to reserve fund, and the balance of £1,677 is to be distributed amongst the holders of "B" stock and ordinary shares in manner provided by the Articles. The business has largely increased during the year, and its resources have been fully employed on important work. Major P. M. Peters has retired from the

board. The loss of Mr. Leslie Robertson (for five years a director) in the *Hampshire*, is also recorded in the report.

Clyde Valley Electrical Power Co.

The profit for the half-year ended December, 1916, was £59,162, plus £15,456 brought forward. After adjusting interest, and transferring £25,000 to contingency fund for depreciation, &c., bringing it up to £192,500, transferring to special reserve £6,920, paying the preference dividend (£9,000), and a dividend of 1½ per cent. on the ordinary shares (free of income-tax) £7,500, there is to be carried forward, subject to Excess Profits Duty, £25,797. The plant and mains have been maintained in efficient repair out of revenue. The new power station at Clyde's Mill, near Cambuslang, has been in operation since November last, and it has now been found necessary to order a duplicate of the plant already installed there in order to meet the demand for power next winter. Col. C. M. King has retired from the board, and Mr. R. Robertson (Strain and Robertson, consulting engineers to the company) has been elected in his place.

German Electrical Companies.

The Lloyd Dynamo Werke, A.G., of Bremen, which undertaking was formed at the end of 1915 with an ordinary share capital of £50,000, reports net profits of £2,400 for 1916, most of which amount has been carried forward.

The financial statement of the *Deutsche Kabelwerke, A.G., of Berlin-Lichtenberg*, indicates gross profits of £65,000 for 1916, as compared with £35,000 in the previous year. Including the balance forward, the net profits are returned at £31,000, as against £35,000, and the directors propose a dividend at the rate of 8 per cent. on the ordinary share capital of £262,000, this contrasting with 6 per cent. in 1915.

The directors of the *Elektrochemische Werke, Bitterfeld*, whose shares are almost entirely in the hands of the A.E.G. group, propose to raise the rate of distribution on the old shares for £275,000 from 10 per cent. in 1915 to 12 per cent. in 1916, whilst 7 per cent. is to be paid on the new shares for £75,000. The operation of the company's works continues to be leased to the Griesheim-Elektron Chemical Works.

The accounts of the *A.G. Mix und Genest, Telephon und Telegraphenwerken, of Berlin-Schoneberg*, show that £39,000 has been placed to depreciation in 1916, as against £40,000 in the preceding year, leaving net profits of £86,000 and £132,000 in the two years respectively. The directors recommend the payment of a dividend at the rate of 18 per cent., being the same as in 1915.

The Ver. Isolatoren Werke, A.G., of Berlin-Pankow, in which the Berlin Electrical Undertakings Co. is largely interested, reports an increase in the gross profits of £12,000 in 1915 to £79,000 last year, of which £3,900 and £37,000 have been applied to depreciation in the two years respectively. The net profits have risen from £600 to £15,000, and the dividend for 1916 is at the rate of 20 per cent. on share capital of £50,000, as compared with no distribution in 1915.

The report of the *Ges. fur Elektrische Hoch und Untergrund Bahnen, of Berlin*, states that the number of passengers carried increased from 69,542,000 in 1915 to 78,700,000 last year, at the end of which the traffic had reached approximately the normal level of the last year of peace. It is explained that the principal reason for the augmentation was to be found in the progressive restriction in the omnibus and motor-cab services, thus causing a diversion to the elevated and underground railway. The former overcrowding of the trains was now to be avoided as far as possible by accelerating the services. The growth in the traffic was accompanied by a considerable expansion in the working expenses for wages and raw materials, and this fact and other burdens caused by the war brought about a further decrease in the net profits. An improvement in this respect was not to be expected in 1917, especially as the cost of labour and materials had again increased, and would presumably continue to a large extent also after the war, and the only remedy lay in an advance in the fares. The net profits amount to £124,000, as compared with £168,000 in 1915, and the dividend on the ordinary capital of £3,000,000 is at the rate of 3 per cent., as compared with 4 per cent. in 1915, 4½ per cent. in 1914, and 6 per cent. in 1913.

Northern General Transport Co., Ltd.

During 1916 labour conditions were increasingly difficult, owing to the need of men for the Forces, and the omnibus services had to be further curtailed, although the demands made upon the company for travelling facilities were heavier than ever. Owing to increasing costs of operation, fares were increased. Shares held by the company in the Gateshead, Tynemouth, and Jarrow Companies stand in the books at a cost of £392,226, and the dividends for 1915 were £23,726. For the year the above three companies set aside for reserves and renewals £25,219, and their total funds amount to £169,860. The company's revenue for 1916 was £35,756 (plus £5,777 brought forward), and after providing for administration expenses, deducting £4,274 for loan and debenture interest, providing £5,515 for renewals, £1,410 is put to sinking fund for debenture redemption, 6 per cent. is paid on the preference shares, and 6 per cent. on the ordinary, leaving to be carried forward £5,689.

Canadian General Electric Co., Ltd.—The report for 1916 shows that a gross profit of $2,225,912 was earned, which is in excess of any previous year in the history of the company. $408,887 has been reserved for depreciation of buildings, machinery and patterns, and in addition $631,603 has been reserved for the amortisation of munitions plants and equipment, leaving a net profit of $1,185,420. From this amount $779,843 has been paid in dividends, leaving a surplus for the year of $405,577. This surplus, added to last year's balance, makes a total of $1,112,696, from which $500,000 has been transferred to reserve, bringing the amount to the credit of reserve account to $3,500,000, and leaving $612,696 to the credit of profit and loss. During the year the mortgage indebtedness on properties purchased has been reduced from $1,367,751 to the sum of $413,813.

Midland Electric Corpn. for Power Distribution, Ltd.—The trading revenue for 1916 was £112,856, and the profit £63,646. The balance to the credit of the net revenue account, after payment of debenture interest, is £33,182, plus £8,932 brought forward. There is put to depreciation of plant and machinery £9,773, writing off of commission and expenses of issues of debentures and shares, and expenses during construction £8,615, transfer to debenture premium redemption account £500; balance £23,226. After paying 6 per cent. on the preference shares and 5 per cent. on the ordinary, there is carried forward, subject to provision for Excess Profits Tax, £11,802. The net capital expenditure for the year in respect of plant, mains, transformers, &c., was £36,916. To provide for this outlay, debenture stock to a total nominal value of £45,600 was sold.

British Westinghouse Electric & Manufacturing Co., Ltd.—Net profit for 1916, £199,346, plus £44,632 brought forward. There is written off patents, goodwill, &c., £25,000; special depreciation of plant, machinery, &c., £44,243; additional reserve for employers' liability, £10,000; 7½ per cent. pref. dividend, £75,000; carry forward, £89,735. There have been charged against revenue the usual expenses for maintenance of works, plant, &c., and in addition there has been applied to depreciation of the same items an amount of £91,144, which includes the special sum above referred to of £44,234 to cover abnormal wear and tear of plant due to war conditions. The position under the Finance and Munitions of War Acts being still uncertain, the amount carried forward is larger. Meeting: April 26th.

Woking Electric Supply Co., Ltd.—The revenue for 1916 was £21,185 (against £20,331 for 1915), less expenses £11,609. Including the amount brought forward and income-tax accumulations, the balance is £10,342. Out of this, debenture and loan interest absorb £2,883, 6 per cent. pref. dividend £3,000, there is put to depreciation and renewals £2,000, to reserve £500, 5 per cent. dividend is to be paid on the ordinary shares, and £638 carried forward. Consumers, 2,101, against 2,131; lamps connected, 119,237, against 106,360. Owing to continuous growth of the business, the directors are still looking towards issuing further debenture stock and ordinary shares. Units generated 1,499,106, against 1,285,940 in 1915; units sold, 1,165,975, against 971,541.

Marconi Wireless Telegraph Co. of America.—The report states that the operations show, before allowing for reserves, a net income of $336,040, as compared with $288,994. Receipts for message traffic with ships show an increase for the year of 9 per cent. over the previous year. The income from investment of surplus funds, amounting to $98,107, decreased $6,824. After setting aside all reserves, the net profit amounted to $259,888, an increase of 46.56 per cent. This amount has been added to the surplus, increasing that account to $801,776 at December 31st last, and the reserve set aside at that date against depreciation amounts to $439,716. —*Financial Times.*

Oldham, Ashton & Hyde Electric Tramways, Ltd.—The revenue for 1916 was £37,008 (compared with £34,822 in 1915), and the expenditure (including £1,504 for debenture interest and £1,500 placed to provision for renewals account) was £25,504 (compared with £25,062), leaving a net profit of £11,503 (compared with £9,760). There is to be placed to reserve £5,502; 5 per cent. is paid on the cum. pref. shares; a dividend on the ordinary shares of 6 per cent. is to be paid, carrying forward £2,782.

W. T. Glover & Co., Ltd.—The directors recommend dividends for 1916 at the rate of 5 per cent. on the cum. pref. shares, and 6 per cent. on the ord. shares. After allocating £6,500 to debenture redemption funds and transferring £15,000 to reserve funds, a balance of £22,025 remains to carry forward, subject to Excess Profits Duty, the amount of which is not yet ascertained.

Yorkshire (Woollen District) Electric Tramways.—The report for 1916 states that the revenue amounted to £76,140, an increase of £4,547. After deducting all expenses chargeable to revenue and setting aside £5,100 to renewals fund, a dividend at the rate of 5 per cent. per annum on the ordinary shares is recommended, carrying forward £3,487.

Aldersley & Wilmslow Electric Supply, Ltd.—During 1916 the total lamp connections increased from 1,092 KW. to 1,133 KW. The profit was £2,815, against £3,064 in 1915. £1,242 was brought forward. Interest on debentures and loans absorbs £1,691, £1,200 is to be put to reserve fund, and £1,166 is to be carried forward.

Melbourne Electric Supply Co., Ltd.—At an extraordinary general meeting called for April 23rd, a resolution will be submitted issuing 70,000 preference shares of £5 each at present unissued as 7 per cent. first cum. pref. shares, ranking *pari passu* with the 30,000 7 per cent. first cum. pref. shares of £5 each already issued.

Monte Video Telephone Co., Ltd.—Interim dividend for the half-year to January 31st at the rate of 5 per cent. per annum on the preference shares, and 6 per cent. per annum on the ordinary shares.

Fairbairn Lawson Combe Barbour, Ltd.—Net profit of £7,807, as compared with a loss for 1915 of £4,241. The directors do not see their way to recommend any dividend on the ordinary shares.

La Plata Electric Tramways Co., Ltd.—After placing £3,000 to the reserve fund, there is a credit balance of £10,048 to be carried forward.

Greenock & Port Glasgow Tramways Co., Ltd.—Dividend of 8 per cent. (16s. per share) on ordinary shares for 1916, £1,200 to reserve, £4,000 to renewals fund, £1,778 to sinking fund for loan redemption, leaving £3,201 to carry forward.

Kalgoorlie Electric Power & Lighting Corpn., Ltd.—Dividend on the preference shares at the rate of 4 per cent. per annum for the six months ended March 31st.

Direct United States Cable Co., Ltd.—Final dividend of 2s. per share, less tax at 5s. in the £, making a total distribution of 4 per cent. for the year ended March last.

STOCKS AND SHARES.

Tuesday Evening.

Continuance of the strength of markets as a whole is the principal Stock Exchange feature. There is considerable buying of all the investment securities, while in speculative markets, rubber shares command the principal attention. Home Railway stocks have maintained their rises, and the expected entry into the theatre of war of the South American States has contributed to the stiffening of the Brazilian exchange and an improvement in bonds, shares, and stocks of that country. Oddly enough, Brazilian Tractions have given way a point or so; but, on the other hand, Anglo-Argentine Tramways are a more robust market than they have been for some time past.

Electricity supply shares are now mostly quoted ex dividend. Bromptons are 6¼, and Chelseas 2⅞, both ex dividend last week. Charing Cross ordinary rose ¼ to 3⅜, and Metropolitans stiffened to 2 7/16, showing an advance of the same amount. Metropolitans are regarded by some as being a cheap speculative investment, inasmuch as the company should now have recovered from its internal troubles; and, with a strong, united board, the outlook should be much clearer, upon any return of normal days, for the rapidly increasing prosperity of the company.

One of the features in the Home Railway market is the strength of Underground Electric income bonds. These have recovered from their recent lowest price of 77½ to their present level of 81½ under the pressure of quiet buying; and the effect has now worn off of the slight scare produced by the suspension of various omnibus services. That the bonds will in due course receive their full 6 per cent. again is considered in the market to be only a matter of time—and not a very long time at that—though it has to be remembered that the interest is not cumulative, but dependent from one half-year to another upon the receipts.

Metropolitans are easier; Districts remain steady, while amongst the lists for prior-charge stocks there are still many more buyers than sellers. The opening this week of the new line from the Elephant and Castle to Watford has quickened interest in the Underground group; and great curiosity is felt as to what result the new feeder is likely to have upon the receipts of the holding company.

The telegraph market once more shows a list of unbroken rises. Anglo-American preferred at 94½ ex dividend is 1½ to the good, though actually this is reduced to 1¼ when the income-tax is taken off the dividend. Eastern Extension and Eastern ordinary are both better. Indo-Europeans again rose £1. Globe Telegraph ordinary at 12 is 5s. higher.

There is not much doing in Marconis, the speculative interest in miscellaneous shares being so largely absorbed for the time being by the rubber animation. American Marconis fell away to 15s. 6d. on the appearance of a report which disappointed a good many by the non-declaration of a dividend. The company, however, is gradually strengthening its position; and although the progress made has not been as much as the optimists expected, the company seems to be moving in the right direction.

Brazilian Tractions, as already mentioned, have given way, the price at 47½ showing a fall of 2½ points. This is difficult of explanation, because all the other Brazilian issues are good, and the exchange is moving in favour of the country. Anglo-Argentine Tramway first preference are 5s. up, and the 5 per cent. debenture at 66¾ is 2 points to the good.

The Canadian General Electric Co. publishes a report showing a flourishing state of affairs. But Canadian utilities are quiet for the time being; and America, which can be counted upon as a rule to provide support, is too much occupied with the war for stocks and shares to receive much attention in Wall Street.

The Mexican group is irregular, Mexico Tramways being easier, while the Mexican Light and Power issues show useful rises. The Mexican Railway announces that the Mexican Government has again acquired control of its property, and this is held to be a disquieting factor, in view of the uncertainty as to which side the Mexican Government is likely to take in the world struggle. British Columbia Electric stocks are disposed to improve, but there is not much change in prices. The 4½ per cent. debenture is ½ up.

Manufacturing shares remain very firm. Callenders are 5s. better. Henleys recovered half their dividend and bonus of £1. Edison Swan 4 per cent. debenture stock is 2 points higher. The most animated part of the miscellaneous market, however, is that devoted to rubber shares, where business continues to be extraordinarily brisk, with prices rising, on balance, day after day. Iron and Steel shares are also better; and the armament issues are bracing up again.

The Stock Exchange has just issued its own annual balance sheet and accounts for the year ended March 25th last. In the latter occurs the item "Electric power, working expenses and maintenance," which is put down at £1,442, against £1,680 in the previous 12 months. This does not include salaries and wages. The Stock Exchange runs its own electric light plant, the machinery being used for illumination in the darker days and for pumping cooled air into the House during the weather which the last six months have made it so impossible to believe we ever get.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price April 17, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6¼xd	—	£6 18 6
Charing Cross Ordinary	5	5	3⅜	+ ¼	7 8 2
do. do. do. 4½ Pref.	4½	4½	8½	—	7 1 2
Chelsea	4	3	2⅞xd	—	5 4 4
City of London	8	8	11⅝	+ ⅛	7 0 8
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 3 1
County of London	7	7	10⅝	—	6 18 8
do. 6 per cent. Pref.	6	6	9⅜	—	6 8 1
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8⅜	—	5 6 8
Metropolitan	3	3	2 7/16	+ ⅛	6 3 1
do. 4½ per cent. Pref.	4½	4½	8½	—	7 4 0
St. James' and Pall Mall	8	8	6½	—	6 10 8
South London	5	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	5⅜	—	6 5 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94½xd	+1½	6 7 2
do. Def.	33.6	1½	22	—	6 16 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	7⅜	—	6 9 0
Eastern Extension	8	8	18½	+ ½	*8 15 4
Eastern Tel. Ord.	8	8	141	+1	*5 13 4
Globe Tel. and T. Ord.	7	7	12	+ ½	*5 16 8
do. Pref.	6	6	9½	—	6 3 1
Great Northern Tel.	22	22	87	—	5 19 0
Indo-European	13	13	48½	+1	6 14 0
Marconi	10	10	3⅞	—	8 9 7
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2½	—	4 14 1
United R. Plate Tel.	8	8	6⅜	—	*8 0 9
West India and Pan.	6d.	6d.	¼	—	2 12 6
Western Telegraph	8	8	13½	+ ½	*5 15 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24¾	— ¾	4 0 10
do. District	Nil	Nil	10½	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	6	5	81½	+2	*6 2 8
Foreign Trams, &c.					
	Dividend 1914.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	3½	+ ½	8 16 0
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	66½	+2	7 10 5
Brazil Tractions	4	4	47½	—2½	8 8 5
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	46	—	Nil
do. do. Deferred	—	Nil	33½	—	Nil
do. do. Deb.	4½	4½	64•	+ ½	6 13 10
Mexico Trams 5 per cent. Bonds	—	Nil	2 ⅜	—1	Nil
do. 6 per cent. Bonds	—	Nil	26	—	Nil
Mexican Light Common	Nil	Nil	9½	+2	Nil
do. Pref.	Nil	Nil	17½	+3	Nil
do. 1st Bonds	Nil	Nil	27½	+5	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2⅞	—	5 4 4
British Aluminium Ord.	5	7	27/6xd	—	7 6 10
British Insulated Ord.	15	17½	19½	—	6 17 3
British Westinghouse Pref.	7½	7½	2½	—	6 0 0
Callenders	15	20	13	+ ½	7 13 10
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	5⅞	—	6 15 0
Edison & Swan, £8 paid	Nil	—	⅞	—	Nil
do. do. fully paid	Nil	—	1⅝	—	Nil
do. do. 4 per cent. Deb.	4	4	69½	+2	5 15 2
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9⅝	+ ⅛	6 4 8
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	15½xd	+ ½	8 1 8
do. 4½ Pref.	4½	4½	4	—	6 12 6
India-Rubber	10	10	11⅞	—	*8 8 4
Telegraph Con	20	20	87	—	*8 9 10

* Dividends paid free of income-tax.

WAYLEAVES.

By C. VERNIER, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Although between 1,000 and 2,000 route miles of overhead electric mains have already been erected under the difficult conditions at present obtaining in this country, the time has come to consider seriously whether the important services which public suppliers of electrical power, light, and heat, must continue to afford—and certainly in a greater measure than ever before—to our industries, manufacturers, railways, and the practically untouched field of agriculture, in the strenuous and difficult times which will follow the present European conflict, do not call for prompt legislative assistance in removing certain difficulties that at present hamper their fullest development.

The need for efficiency and economy will be so seriously accentuated, both in regard to a more efficient utilisation of our seriously depleted capital and also in regard to the conservation of our natural resources, of which in this country coal is unquestionably the most important, that there is every reason to expect that electrical services which can so eminently achieve both these objects will be sought for to an unprecedented extent after the war.

The advantages and economies which can be derived from the generation of electrical energy on a large scale, or from the centralisation or linking-up of existing electricity supply undertakings, are now generally recognised. The present paper is more closely concerned with securing to the fullest possible extent the advantage of the economies in capital cost which can be effected by the use of overhead wires for interconnecting, transmitting, and distributing mains across open country, and the no less important economies which can be obtained by laying underground mains wholly or partly on private property whenever the use of such mains is found desirable. On 20,000-volt mains the saving in capital cost which can be effected over an equal length of route by the use of overhead wires as against the use of underground cables is in the neighbourhood of 50 per cent., excluding the cost of wayleaves in each case. At higher voltages it is yet greater; while by using cross-country routes for underground mains, instead of keeping strictly to public roads, a saving in capital cost of 30 per cent. is not uncommon on routes of several miles, and even more on shorter lengths, as the result of shortened routes and cheaper reinstatement of the ground. It must further be borne in mind that although the Board of Trade are willing to allow extra-high-pressure overhead lines on public roads, subject to strict requirements regarding public safety, practical considerations usually render this, if not quite impracticable, at least extremely undesirable, and therefore all such lines must ordinarily be placed on private property. We have also to face the probability that, in the near future, much higher transmission pressures will be employed, and this cannot in the present state of the art be satisfactorily dealt with (if at all) by underground cables.

The difficulties already referred to in the use of overhead wires for extra-high-pressure transmission, fall conveniently under two heads, viz., "Consents" and "Wayleaves."

Consents.

The Electric Lighting Acts contain clauses to the effect that (1882) the undertakers shall not be authorised to place any electric line above ground, along, over, or across any street without the express consent of the local authority, and (1899) shall not, without the express consent of the Board of Trade, and of the local authority also, place any electric line above ground except within premises in the sole occupation or control of the undertakers.

There can be no appeal from the decision of a local authority in this matter, which may refuse its consent without assigning any reason or may attach unreasonable and onerous conditions thereto, or cause unreasonable and vexatious delays. There is only one usual exception to this procedure, *i.e.*, in the case of the Power Acts, where an appeal to the Board of Trade is allowed in the event of a consent by a rural district council being unreasonably withheld.

The anomaly of the position will be better appreciated when it is pointed out that any private individual or company who cares to undertake the transmission or distribution of electricity without statutory powers—which can be and is commonly done, for example, by colliery and quarry owners and others, as there is no restriction placed upon it so long as electricity supply to consumers is not the chief business of the undertaker—is perfectly free to erect overhead wires over private land without the consent of the local authority, and can quite well carry such wires across public roads and footpaths, provided the local authority are not the owners of the land on either side of the road, and that care is taken not to contravene any by-laws which the local authority may have adopted, and further, in the absence of special by-laws, that the highway is not itself interfered with or broken up, and that its ordinary use is not restricted in any way.

As an example of the difficulties and delays imposed upon statutory company undertakings by these restrictions, in one case seven and a half months elapsed before a commencement could be made with the work, and nine months before the consent was finally given.

In another instance, consent was given only provided that where the line crossed any road, street, or footpath, it must be placed underground at a minimum cover of 3 ft., and that if any new road or street were laid out on the land where the line was situated, the line should be placed underground.

In another case, application was made to a rural district council for consent to the erection of overhead wires wholly over private land, except where roads and footpaths were met with. This consent was granted on condition that the line be placed underground where it crossed any road, bridle-path or footpath. Fortunately, in this case, the local authority being a rural district council, there was a right of appeal to the Board of Trade. Such an appeal was therefore entered, and subsequently allowed by the Board of Trade. The total time taken to obtain this consent was over nine months.

These examples may serve to illustrate how many of these local authorities have but the haziest idea of why they stand possessed of the powers conferred in the clauses of the Acts already quoted. Some, and fortunately a good proportion of these local authorities, treat the matter as a mere formality to be complied with by the undertaker and consent readily; others, in the absence of proper enlightenment, usurp functions which properly belong to the Board of Trade; while in other cases it is difficult to discern the existence of that public spirit which one might look for in the representatives of an important community.

I am strongly of the opinion that it is essential that a right of appeal to the Board of Trade should be allowed in all cases, and that while the local authority should have the right to be heard, it should have no absolute veto on such questions, and that all powers of interference in technical questions, such as design, and questions of the public safety, without a reference to the Board of Trade, should be absolutely taken from them.

A time limit should further be determined, say, one month, as in the case of works on public roads, during which a local authority must either signify or refuse its consent, failing which such consent will be deemed to have been given, as the unreasonable delays which are at present possible in some cases should not be tolerated.

Wayleaves.

Electricity supply, gas, and in some cases water, undertakers are precluded by law from laying their mains in private lands without special consent, and this is only possible by a complete agreement for an easement or wayleave with the owner and occupier, and upon such terms and conditions as he or they may in their entire discretion impose upon the undertakers.

The above restrictions have been found to be a source of serious inconvenience and unnecessary expense, and a hampering obstacle in the development of electric power supply on a large scale, and in the full achievement of the economies resulting therefrom.

Cases of absolute refusal to grant an easement or wayleave have been in my experience fortunately of rare occurrence, but it is otherwwise with the imposition by landowners of unnecessarily oppressive conditions, chiefly the exacting of outrageously exorbitant rents, having regard to the use which is made of the land and its value to the owner,* and with some exceptions in their exercise of procrastination and utter indifference to industrial needs in dealing with such matters.

Only a very few cases need be cited, as doubtless the ensuing discussion will bring to light many others:—

1. A landowner (an eccentric old lady), without assigning any reason, refused to allow any cables, pipes, or poles whatever on her land.

2. The agent to a large landowner, when first approached, was inclined to grant a wayleave on reasonable terms. Subsequently, owing to a claim for damage having been served upon a firm in which this agent was interested (unknown at the time to the applicant) he plainly intimated that he would set one case against the other. He was subsequently induced to moderate his views, but the claim for damage had eventually to be abandoned.

3. A landowner, after leading the applicant to believe that a certain wayleave over his land would be granted, kept delaying his final consent on some pretext or other. After nine months of this sort of thing, when pressed more than usual, he took offence, and definitely refused to consider the matter any further. It was, therefore, necessary to incur additional expense in laying this section underground.

4. A charity trust, whose meetings were only held quarterly, was applied to for a wayleave. After repeated delays, a reply was received that the wayleave would be granted, provided the applicants would undertake to give a supply of electricity to one of the trust's institutions in another part of the district, which necessitated a special main. It was fully 18 months before the permission could be obtained to start work. The line was nearly 20 miles long, and all other wayleaves had been granted some nine months before this last consent could be obtained.

5. A colliery company owning land in various parts of the district held up wayleaves in two places on overhead lines

*Rents for agricultural farm land vary from 5s. to 60s. per acre, with probably 25s. to 30s. per acre as a fair average.

some 30 miles long, taking advantage of the opportunity offered to negotiate favourable terms for a supply of electricity to a colliery.

As a rule, where a landowner employs a full-time agent to look after his property, delays are seldom so serious as in the case of smaller owners who have to deal with the matter themselves or through a solicitor.

A frequent cause of prolonged delay is that one or more owners, after the usual initial delay in replying, which varies according to the individual, make objection to the route selected over their land. Negotiations must then be reopened with other owners, who probably have already given their consent, to allow of a diversion of the route on their estate, and in consequence they not infrequently come to the conclusion that the applicant does not know his own mind, which is not usually conducive to a speedy settlement. If, in addition, a local authority should call for a diversion of the route when negotiations with landowners are well advanced, it is readily perceived how delays become cumulative.

I purposely refrain from quoting some of the onerous conditions which landowners have sought to impose, in some cases with success, as in the existing condition of things such information might adversely affect future negotiations.

Cost of Wayleaves.—Compensation for an easement or wayleave is almost invariably given in the form of an agreed annual rent, based either on a fixed sum per pole or per yard of route, or an annual lump sum payment to cover a particular stretch of route between fixed points.

Rents have steadily risen during the past seven years, and especially since the war began.* This is partly because landowners who at first treated wayleave rents merely as a convenient addition to the rents which they already received for the ordinary use of their land, have more and more come to regard wayleave rents as quite a useful source of additional revenue, and, especially since the war scale of taxation came into force, have made the most of their opportunities.

Moreover, as it is usually quite impossible to bring the slightest pressure to bear in negotiations for wayleaves, it has in unavoidable cases been necessary to pay some recalcitrant landowner a heavier rent than usual in order to complete wayleaves for a route. Other landowners have come to hear of this rent, and have asked for the same terms.

The following examples may serve to indicate the measure of the extortionate demands which are exacted :—

1. At the present time it would be more advantageous, on financial grounds alone, to electrical undertakers in some parts of the country to rent a strip of land wide enough for many a London street for the whole length of an overhead line at the same rents per acre as landowners secure from their tenants for some of the very best of the agricultural land in this country, and such that even if this strip of land were put to no other use the landowner would suffer no pecuniary loss.

2. Alternatively, and subject to the same assumption, it would in many cases be a satisfactory business proposition from the point of view of the undertakers to rent the whole area of specified fields along the route, on agricultural tenant's terms, provided the right to sub-let for agricultural purposes were allowed.

The iniquity of these charges can be further appreciated when it is mentioned that only approximately one-half of 1 per cent., on a liberal estimate, of the land mentioned in paragraph 1 is actually diverted from its ordinary use in connection with an overhead line on arable land, and less than one-quarter of 1 per cent. on grazing land.

If these charges may fairly be termed iniquitous in the case of overhead lines, what should be said of the same rents which are now frequently asked for wayleaves for underground cables? Underground cables when once laid generally require no further attention for many years, and do not obstruct or interfere in any way whatever with the ordinary use of the land; in fact, their very existence is usually forgotten by everyone except the undertaker and the grantor of the wayleave when he receives his rent.

Additional compensation has to be paid for all damage to crops, drains, fences, &c., occasioned in the laying down or erection of the work, or its subsequent repair and maintenance, while invariably there is a clause in the agreement for the diversion of the main at short notice at the sole cost of the undertaker.

Hitherto I have only discussed the landowner's rent, but the tenant or occupier (if any) has also an interest in the land, for which he should receive compensation. There are alternative methods of dealing with the occupier. The first is to agree upon terms with the landowner on the understanding that he settles with his own tenant. This is the basis on which the cost of wayleaves discussed above has been considered. As a rule, landowners prefer this procedure. The second method is to agree upon a rent with the landowner based on the applicant agreeing to make terms with the tenant. This is not a method to be recommended.

Compulsory Powers for Expropriation.—There are two points of view from which the question of electricity supply undertakers being granted compulsory powers for carrying their mains over or through private land may be regarded. These are briefly, on the one hand, that such undertakings afford a valuable public service, and that any source of unnecessary expense in furnishing such service is ultimately a serious handicap to industry and production, and consequently contrary to the national interest. The other is that these undertakings—I here refer to company undertakings—are a source of private profit, and any saving of expenditure merely increases profits to shareholders.

The latter is undoubtedly the view that weighs chiefly in the minds of the majority of individuals and private and public bodies when they have the power, as in this case, to exercise their absolute discretion in granting or refusing a concession. Although it is evident that Parliament has already afforded some measure of recognition to the public service character of electricity supply undertakings, especially power company undertakings, by the grant of special privileges, such as the right to break up streets and roads, the compulsory acquisition of land for their works, and, on the other hand, the imposition of specified duties under penalties, and of control, including the regulation of maximum charges and dividends, it does not appear hitherto to have fully recognised the not unimportant part which electricity supply has played in the national economy during the past 10 years, or which it is destined to play in a much larger, and even perhaps an extraordinary, degree in the near future, provided encouraging facilities are afforded for its development.

Compulsory power for expropriation for works of public utility, or, as is better known in the United States, the power of eminent domain, *i.e.*, the sovereign right of a State to appropriate private property to public uses, whether the owner consents or not, exists in most European States, including Italy, Switzerland, France, Norway, Spain, Holland, Belgium, and possibly other countries, and also in the United States.

In Italy, Switzerland, and France further enactments on expropriation have been applied to the carrying of electric mains (either overhead or underground) over or through private land, while in Norway the general law on expropriation is available for this purpose.

In every case it is necessary to satisfy the authorities, *i.e.*, either the Crown, the Legislature, or a Government Department, that (*a*) the undertaking or (*b*) the proposed main is one of public utility, before these powers can be applied.

In the United States, under a recent law, easements for rights of way over public and national lands can be granted by the State, but I am not aware that otherwise the ordinary procedure is in any way different from ours, *i.e.*, by negotiation and agreement with the owners. Owing to the comparatively low cost of land in many parts, however, it is quite a common practice for electric light and power undertakings to purchase a strip of land for at least their most important lines, and elsewhere to use the public roads as far as possible, even for extra-high-pressure overhead lines.

The United Kingdom and Germany are the only two large European States which, having reached a high state of industrial development (perhaps in some measure because of this), have not yet adopted compulsory powers for expropriation for electric mains on private property.

In this country, with a few exceptions, the only statutory powers which are at all analogous to the right of expropriation or of eminent domain, are the compulsory powers for the purchase of land under the procedure laid down in the Lands Clauses Acts.

We are not here, however, concerned with the purchase of land for routes for our mains, nor should this be at all necessary. The present procedure for the compulsory purchase of land is altogether too clumsy and costly to render its adoption practicable for such a purpose.

There are, however, interesting precedents in our own legislation which afford to certain authorities the right to secure compulsory easements over private land.

(*a*) A local authority under the Public Health Act, 1875, may carry sewers and water mains through any private land whatsoever without taking the land or purchasing an easement, but only subject to compensation.

(*b*) Under a short Act passed last year—Telegraph (Construction) Act, 1916—the Postmaster-General is empowered to erect or lay down overhead or underground telegraphic lines on private land by serving a notice upon the owners, lessees, or occupiers of the same, and any difference between the parties is to be referred to a stipendiary magistrate, a judge of a County Court, or in Scotland a sheriff, with a right of appeal to the Railway Commissioners.

In the Act of 1916 there is no restriction as to motive, so long as the proposed line *is in the public interest*. So far as I am aware, there is not a single case in which the powers conferred by the Telegraph Acts of 1892 and 1908 have been exercised, and the working of the more recent Act of last year will be watched with great interest.

(*c*) In India under powers conferred by the Indian Telegraph Act, 1885, the telegraph authority is entitled to place telegraph lines and posts in or upon any immovable property.

Our special interest in these clauses lies in the fact that they have been extended to electricity supply undertakers in certain cases, and also in regard to the diversion clause contained in the Act.

The Land Inquiry Committee's Report.—In 1912 the then Chancellor of the Exchequer (Mr. Lloyd George) appointed a small private committee to inquire, amongst other matters.

* These rents have in my experience approximately doubled since the war, and more than trebled during the past seven years.

into the "nature and workings of the existing systems of ownership, tenancy and taxation and rating of land and buildings in urban districts and the surrounding neighbourhoods, and their effect on industry and the conditions of life." The report of this committee refers to the question of wayleaves in the following terms:—

"Public bodies are often called upon to pay large sums for such easements, and private firms are affected similarly when they are unable to get consent to the laying of pipes for the service of necessary water or electrical power. . . . Modern developments of the use of electricity to supply power at a distance from the spot where it is generated have given increased importance to this question. Wires have to be carried across country, and here, too, each owner whose land it is proposed to traverse is enabled to hold the scheme up by demanding an excessive price for permission to carry the wire across his land. In some cases he is enabled to prevent it altogether. . . . We believe that the State should exercise the power of compelling the grant of easements and wayleaves of all kinds.

"Therefore we recommend:—

"1. That the Government Department authorised to give such sanction should have the power to make an order for the compulsory acquisition of easements or wayleaves for any purpose.

"2. That in all cases where any such order is made the terms should be fixed by the Judicial Land Commissions.

"3. That in all cases: (*a*) The local authority and the landowner should both be enabled to appear before the Government Department and the landowner before the Commissioners.

"(*b*) The amenities of the neighbourhood and the interests of the landowner should be considered, and injured as little as possible.

"(*c*) The term 'landowner' should include all who have substantial interests in the property."

On the question of the present procedure for assessing compensation under the Lands Clauses Acts, the Committee state:—

"We are of opinion that a permanent tribunal cheap and easy of access, with wide powers in respect of limiting evidence and disallowing costs, should be substituted for the present procedure. Such a tribunal would take the form of a court or a commission combining a strong judicial element with expert members. The latter should be professional men not in private practice who would be retained in the service of the court or commissioners, thus adding independence of judgment to their professional skill. We had intended to recommend a court, but the proposals of the Government to constitute a body of Judicial Land Commissioners for dealing with questions of tenure and compensation fully meet our views.

"Therefore we make the following recommendations with regard to the tribunal for assessing compensation, its procedure and costs:—

"(*a*) That in all cases where land is acquired under compulsory powers, the final determination of the purchase price, the assessment of the compensation for severance and disturbance due to the claimant, and the apportionment of the compensation as between several claimants, should be determined by the Judicial Land Commissioners.

"(*b*) That the procedure for determining the amount of compensation for the land taken should be as follows:—

"1. At the time of applying for compulsory powers the promoters should serve a notice on the district valuer and all interested persons, as to the lands to be acquired.

"2. If and when the compulsory powers are obtained, the district valuer should assess the market value of the property to be acquired, as at the time of the application for compulsory powers provided that where the owners or persons interested are unable to agree to the valuation they should have the right to appeal to the Land Commissioners against the valuation of the district valuer.

"As to costs, we recommend that:—

"(*a*) A scale of costs and fees in compensation cases should be prepared by the commissioners.

"(*b*) It should be in the discretion of the commissioners to award the whole costs of arbitration in any proportion as between the promoters and the claimants provided that when the finding of the commissioners is less than the offer made by the promoters, the costs should be paid by the claimant, unless otherwise ordered by the commissioners.

"(*c*) The commissioners should have discretion to limit the number of witnesses and to exclude counsel."

I have freely quoted from the above report, as, in my opinion, not only would the adoption of the Committee's recommendations go far to overcome satisfactorily most of the present difficulties in connection with obtaining wayleaves, but, further, any action which might be taken in order to secure legislative assistance would, if on these lines, be more likely to meet with Government support.

The report formed the basis of the Land Reform proposals outlined on behalf of the Government by Mr. Lloyd George at Bedford and Swindon in October, 1913, which included the formation of a Ministry of Lands and the appointment of Judicial Land Commissioners. Owing to the war, these proposals have had to be abandoned, but I believe that the war will have facilitated the adoption of these or similar measures to an extent unthinkable in pre-war times.

The drastic powers exercised by the State during the war under the Defence of the Realm Acts will have accustomed everyone, legislators and the public alike, to the idea of State interference with private rights in anything that concerns the public interest, and the vital importance of rendering the nation as self-supporting as possible in the future, both industrially and in regard to agriculture, will call for much more intelligent State aid and oversight than in the past, and in many previously neglected directions.

It is obvious that no new legislation of this nature can be considered by Parliament during the period of the war and for some time after, but I suggest that the Council of the Institution would do well to formulate proposals and consider without delay the best means of securing their adoption.

The Land Committee's recommendations have, however, one serious defect, in that no definite period of time is appointed during which consents must either be given or an order be made by the Government Department concerned. Time is all-important in industrial matters.

It appears inconceivable that the present procedure in connection with the acquisition of land for general public purposes, including electricity supply, can for long remain unchanged after the war, but in the event of the Government showing no intention of proceeding within a reasonable period after the declaration of peace with the former proposals, I submit the following for discussion, which utilise existing machinery and are not inconsistent with precedents in our present legislation.

(*a*) That, failing agreement between a statutory electricity supply undertaker and a landowner or occupier for a wayleave for electric mains on private property, or if a landowner or occupier refuses to give a consent or fails to give a reply in writing within one month from the date of application, the Board of Trade be authorised, after inquiry, to make an Order for a compulsory wayleave within a further period not exceeding two months. In all cases the undertakers would have to satisfy the Board of Trade as to the commercial and other considerations which render this course necessary.

(*b*) That, failing agreement between the parties as to the annual rent to be paid by way of compensation, this be determined by one of the following methods:—

1. By a single arbitrator (who should be an expert) appointed by the Board of Trade, counsel and expert witnesses being excluded from the arbitration proceedings. The Board of Trade with the concurrence of the Lord Chancellor to be authorised to fix a scale of costs and disallow costs unnecessarily incurred.

2. By the valuation of two surveyors, one of whom shall be appointed by one side and one by the other side, and in the event of their not being able to come to an agreement, by a third surveyor appointed by two justices or a stipendiary magistrate.

In fixing the wayleave rent, regard should be had to the average annual rent (if any) received from the land under consideration during the previous seven years, and a reasonable percentage should be added to cover permanent damage, disturbance, or inconvenience which may arise from the proposed works, and for the right of entry upon the land. This percentage would obviously be greater for overhead wires than for underground cables. The arbitrator or valuer should not be allowed to take into consideration any saving in expenditure which is afforded to the undertakers by the grant of wayleave, but should apportion the rent equitably between landowners, tenants, and occupiers, and all who have a beneficial interest in the land.

Any of the parties, failing agreement, should have the right to apply for a revision of the rent once in every seven years. Damage to crops, &c., caused in the execution of the work, should be settled separately and in the usual manner.

(*c*) That in cases of urgency, the undertakers be authorised to enter upon the land and commence the execution of the work as soon as an Order has been made by the Board of Trade, and before the assessment of the compensation, upon serving a notice, making a satisfactory deposit, and giving bond.

(*d*) That a right of appeal to the Board of Trade be allowed in all cases where a landowner or occupier demands the removal or diversion of a main at the cost of the undertakers which in the opinion of the undertaker is unreasonable or unnecessary.

The success or failure of any proposals such as these would obviously depend upon the degree of "public utility" which might be attached by the Government Department concerned to the various kinds of electrical services, but even if compulsory powers were only granted in important and difficult cases, the mere existence of such powers and the possibility of the grantor of a wayleave having to justify his demands would, I believe, exercise such a moral effect that in many cases an agreement would be possible without putting into operation the machinery created. It would materially assist in this very desirable consummation if undertakers were enabled to secure a declaration from the Board of Trade of the public utility of a proposed main for which wayleaves are required before negotiation is entered into with landowners and others, in all cases where the Board is satisfied that the public interest justifies such a declaration.

Discussion.

Mr. C. H. Wordingham, in opening the discussion, said the paper was intimately connected with the success of the electrical industry, and was eminently fair from beginning to end. It was essential that we should be able to run overhead and underground mains by a direct route, and also true that existing rights should be respected. He considered that Mr. Vernier's proposal for appeal to a tribunal with compulsory powers was a good one.

Col. Ogilvie thought the tendency would be for Parliament to be much more willing to consider new legislation now than at any previous period, as evidenced by the grant of powers to the Post Office last year. The existing statutory powers for lines over private property were not satisfactory; the private individual was in a better position as regarded freedom of action than the statutory authority. The Postal authorities, in the past, had suffered a great deal in obtaining wayleaves from local authorities, and it was extraordinary what a great number of road authorities there were, whose powers applied equally to power lines and postal lines. The Post Office experience in dealing with stipendiary magistrates and county court judges was that most uncertain and freakish judgments were given, and he would prefer always to have the right of appeal to a regularly constituted body such as the Railway Commissioners.

Mr. W. B. Woodhouse said that legislation on the subject of wayleaves was quite antiquated, and they must make out a strong case if it was to be altered. Additional reasons could be advanced for greater wayleave facilities, as in many districts it was better to run mains overhead than underground on account of the danger from subsidence; also they had to consider in the future the transmission of very large powers, which would require a wide strip of land to enable many lines to get away from the power station. The question of agricultural and railway supply also called for further wayleave facilities. It was not claiming too much to say that electric power requirements were quite as important as those of the telegraph and telephone in the matter of obtaining wayleaves. He saw no reason to distinguish between county boroughs and urban councils as regarded powers, as the former often embraced equally rural country. A difficulty was encountered under the Settled Lands Act, in that a wayleave could only be given for 21 years; again, when dealing with trustees, &c., legal expenses mounted up, and they were in general very heavy. He recently secured an agreement, terminable at six months' notice, for six poles, which cost £9. As showing the difficulties encountered, he cited a case of a local authority which, while quite willing for a 10,000-volt overhead line to pass through its area, asked that the wires should be continuously insulated. He thought it would help matters if they said they supported in principle all the recommendations made by Mr. Vernier.

Mr. D. A. Starr said he was glad that in the Scottish area with which he was connected, they had less difficulties to contend with than in England; they had many miles of line on private land, and a special department had been formed for negotiating wayleaves. He thought the question of lines over private roads open to the public, and on roads passing over or under railway bridges, was as important as that of lines passing over agricultural lands. In some cases the farming community welcomed their lines, and took a supply through pole transformers. The projected "Supply of Electricity Bill" contained a clause dealing with wayleaves which, if passed, would cover the author's recommendations.

Mr. A. J. Stubbs, with regard to legislation, said the Post Office would no doubt find it necessary to secure the Postmaster-General's rights in the matter of wayleaves, but, apart from this, they were brothers in arms. He thought it would be agreed that the Post Office had priority in the use of roads, and ventured to suggest as an alternative to the proposals in the paper that it would be easier to draft a small Bill conferring on power engineers the same privileges as already held by the Post Office authorities. He suggested, as regarded the proposed reference to the Board of Trade, that that body was rather a controller of electric supply powers than one able to act judicially, as was the case with the Railway Commissioners.

Mr. J. C. Wigham asked why anyone should have the right to refuse permission for running lines overhead; a private supplier could not be prevented from doing it. The important part of the wayleave question was the "consents"; various suggestions had been made, and he only wished they had the same powers as the Post Office, but doubted whether Parliament would grant so much. He agreed with the proposal to refer to the Board of Trade matters of compensation, and in the draft bill of the Joint Committee a similar reference was made to the Board of Trade, with a further important stipulation that the same arbitrator should sit continuously. The question of forming a judicial electrical committee was urged before Sir Charles Parsons's Committee, and he thought that that was wanted, and was really better than having an arbitrator appointed by a Government department.

Mr. E. T. Williams urged that this was not the time to consider the matter, but the time to act. He submitted figures of costs of wayleaves, showing the great divergence in values; in many cases recently, however, powers had had to be taken under the Defence of the Realm Act to run transmission lines, which was evidence of the necessity of altering the law. He suggested that the proposed Electricity Board should be added to the Board of Trade in the author's recommendations. They must be reasonable in their requirements to avoid opposition, and he thought that a slight modification of the 1916 Telegraph Construction Act would meet the case. Electricity supply must be represented by a concrete body before its representations would meet with success. If London's water supply and dock improvements justified the creation of a public body, then surely the electric supply of Great Britain was important enough for such a body.

Mr. H. M. Sayers said he found that the Spanish wayleave law substantially followed the Italian law, and he proposed to send a translation to the *Journal*.

Mr. J. E. Kingsbury said the author concluded with certain sound proposals, and the only question was what could be done to forward the object of the paper. The proposals embodied in the 1916 Post Office Act had actually been officially put forward in 1885, and, in view of the time taken to secure them, it was very necessary to make an early move in the wayleave question. They were suffering from a lack of public appreciation of the difficulties and iniquities of the question; if the public realised that the refusal of a wayleave resulted in disadvantage to the community, the position would be better appreciated.

The President (Mr. C. P. Sparks), in the course of a few remarks, said the paper resulted from the work of the I.E.E. Committee on Electricity Supply. The question of obtaining suitable outlets from large power stations was so wrapped up with electricity supply that it was felt advisable to have a paper read on the subject. Hence, Mr. Vernier was invited to deal with the question, and the Council that day had awarded him the Paris premium for his paper, the reception of which by the meeting proved that they had selected the right man for the work. In the present state of the law, the non-statutory undertaking was immensely better off than the statutory one as regarded overhead lines. In one case with which he was concerned, the lines extended 10 miles, and it was easy to get wayleaves. No local authority could refuse permission to cross roads; moreover, the private owners and the railway companies were both interested parties, as regarded the industry in question, and could not easily refuse wayleaves. He felt that the necessity for granting greater powers would be forced on the legislature in the next year or two.

The Author, in replying, said he was glad there was general agreement on the subject; the present was the most propitious time to deal with it, and he felt that the Board of Trade Committee would be compelled to give it consideration. The Scotch undertakings were in a better position; it was only in Scotland that the County Council was the local authority. He remarked that the Newcastle-on-Tyne Co. also had a wayleave organisation of its own. Some of the difficulties met with by the smaller undertakings were due to the lack of such an organisation. The railway companies claimed wayleave rental if the construction touched the structure of a bridge; a standard charge had been fixed to meet such cases. He thought that a charge per unit was iniquitous; the railway company had nothing to do with the amount of energy transmitted. The Postmaster-General seemed to own the earth and the air, though he provided only one kind of public service; personally, he thought the Postmaster-General should not have quite so extensive powers, but he got on very well with the Post Office engineers. Parliament had not yet realised the importance of electricity supply and the economies that could be effected by its means. The Electricity Board suggested by Mr. Williams would be a very good thing, if and when appointed, and could deal with the question of compulsory wayleaves. If they got the powers, let them be *useful* powers; the French law was useless in some respects. He was sanguine that the powers desired would be secured in two years or less.

ALUMINIUM PRODUCTION BY ELECTROLYSIS.

By RICHARD SELIGMAN, Ph.Nat.D.

(*Abstract of paper read before the* Institute of Metals.)

In the course of his paper on "Electric Furnaces as Applied to Non-Ferrous Metallurgy," Prof. Stansfield describes the production of aluminium by the electrolysis of a fused mixture of cryolite and alumina, and illustrates the course of the main reaction by means of the conventional formula

$$Al_2O_3 + 3C = 3CO + Al_2.$$

In a communication on this paper Dr. G. H. Bailey points out that this formula does not truly represent the changes which take place.

As Prof. Stansfield correctly states, it has been assumed heretofore that carbon monoxide is the sole gaseous product of the electrolytic reduction of alumina.

This was the generally accepted view when the present writer approached the subject at the beginning of 1906.

A correct appreciation of the mechanism of the reaction whereby aluminium is produced in the electric furnaces is of very great practical importance, because the anode consumption is one of the main items in the cost of production of aluminium, and it is clear that if the assumption be made that for every three units of aluminium produced two units of carbon must necessarily be consumed, a downward limit is put to the possible reduction of this source of expenditure.

From observations made of the electric furnaces at work, the writer soon reached the conclusion that the accepted "theoretical carbon consumption" was a myth, and that it should be practicable to work with a far lower consumption than had up till then been considered possible. At that time, however, he found his efforts to improve the carbon ratio hampered by the assertion that it was useless to spend money on experiments with the object of reducing a consumption which already approached very nearly to the figure demanded by "theory." Nevertheless, in a series of large-scale experiments made avowedly with a different object a carbon consumption of well below the "theoretical" figure was attained early in 1907. Experiments on a larger scale and in many directions were immediately started, and by the summer of 1907 the fact that carbon monoxide was not necessarily the sole gaseous product of the reaction had been finally demonstrated. As a result of the explosion of the fetish of a "theoretical" carbon consumption of 66 per cent., the present-day consumption has, as Dr. Bailey says, been reduced to a very much lower figure, with financial benefits which are very considerable. The improvement attained has been accompanied by a number of subsidiary advantages.

Some further experiments were carried out by the writer with the late Mr. H. B. Phillimore. Owing to the difficulties experienced in eliminating atmospheric contamination in a commercial furnace, these experiments were made on a laboratory scale in the electrical department of University College, Gower Street, where Prof. Fleming kindly gave facilities for the work to be done.

Experiments so far published upon the production of aluminium on a laboratory scale have, in their efforts to simulate practical conditions, always overlooked one of the most important, namely, current density. It is well known that in the aluminium furnace the heating is done by the electrolysing current, no external source of heat being required. Experimenters have been anxious to reproduce this condition, but have overlooked the fact that the loss of heat from a laboratory furnace is far greater, proportionately, than that from a full-size commercial unit. In order to make up for this loss of heat, current densities have been applied which are far in excess of those used in practice, and consequently the conditions obtaining in these laboratory furnaces have been totally different from those found in practice.

Mr. Phillimore and the writer considered that the question of the source of heat was entirely irrelevant, and that in order to construct a laboratory furnace which would truly represent the practical conditions, external heating would have to be applied so as to neutralise the excessive loss of heat to which these diminutive furnaces are subject. By constructing such a furnace, the external source of heat being either gas or electricity, it was found possible to produce aluminium under normal conditions in a bath having a capacity of about 150 grm. of electrolyte only. So far as the experiments went they indicated that all the phenomena of a large furnace could be reproduced "in parvo" by this simple device.

In order to prevent the infiltration of oxygen the electrolysis was carried out in a slow stream of nitrogen. Under these conditions gases containing more than 3 vols. of CO_2 to 1 vol. of CO were obtained before the experiments were interrupted, temporarily it was then thought, but in fact permanently.

Dr. Bailey in his communication rightly demolishes the old accepted formula, but replaces it by another, namely—

$$2Al_2O_3 + 3C = 2Al_2 + 3CO_2.$$

The view of the writer at the time was that the primary product of the electrolysis was oxygen, and that whether oxygen, carbon dioxide, or carbon monoxide resulted was dependent upon such factors as temperature, current density, physical properties of the carbon anode, rapidity with which the gases were removed from contact with the anode, and similar factors. The experiments designed to prove the correctness or otherwise of this view had to be abandoned before any decision had been reached.

SUBSTITUTION IN ELECTRICITY WORKS.

THE following is a copy of a circular-letter issued under date April 16th, 1917, to members of the Incorporated Municipal Electrical Association by the Hon. Secretary, Mr. C. Faraday Proctor :—

SUBSTITUTION IN RESERVED OCCUPATIONS.

Dear Sir,—I beg to enclose a questionnaire which I shall be obliged if you will kindly fill in and return to me at the earliest possible moment.

I have to inform you that a deputation consisting of representatives of the

I.E.E.,
I.M.E.A.,
I.A.E.P.C.,
Conference of Chief Officials of the London Electric Supply Companies, and the
Association of Provincial Electric Supply Undertakings of Great Britain

was received by the Reserved Occupations Committee at their offices, St. Ermin's Hotel, on Wednesday, March 28th, at 3.30 p.m., under the chairmanship of Mr. Graves.

The various speakers on behalf of the deputation drew attention to the following, amongst other matters :—

The great importance of the electricity supply industry, both from the public utility and the munitions standpoint.

The very large number of employés affected and amount of machinery dependent upon electricity supply, and the comparatively small number of employés engaged in electricity works in relation thereto.

The danger of too severe cutting down of the staff and employés in electricity works.

The necessity for considering the employés in electricity departments from the standpoints of technical capability, experience and physical fitness.

The difficulties, dangers and limitations of "substitution."

The employment of disabled soldiers and sailors and women and girl labour.

The shortage of labour in the neighbourhood of some large undertakings.

The difficulty, and, in some cases, the impossibility of making even slight reductions in staff of small undertakings.

The necessity for each case to be considered on its merits by expert advisers.

The fact that woman labour is employed in some instances to the extent of 25 per cent. or more, but that the extent necessarily depends upon the local, climatic, and social conditions.

The chairman stated that the recent de-badging was carried out upon the order of the Cabinet direct, and Tribunals should appreciate the fact that it was not, and is not, intended to be a mandate that all de-badged men are to go into the Army, but that it is still for the Tribunals to consider the circumstances of each case, and that a reasonable time should be given for the provision of substitutes.

The chairman stated that the Committee were fully alive to the position and importance of the electricity supply industry. It was not their intention to interfere with skilled men.

It was agreed that a circular letter be issued by the respective Associations to their members, particularly impressing upon them the necessity of closely following up the suggestions made in the letter and memorandum addressed to the I.M.E.A. by the Reserved Occupations Committee on February 5th, 1917,* and that statistics of the staff and employés of electricity works be obtained now, and further statistics in two or three months' time, to show what further substitution had taken place, and when a further conference would be held.

SCHEDULE 1.

Statistics for March 31st, 1917.

(a) Number of employés, July, 1914 ..
(b) Number of employés released for service with Colours to March 31st, 1917 ..
(c) Number of employés, March 31st, 1917 ..

Analysis of (c).

(1) Number under Military age (18)
(2) Number over Military age (41) ..
(3) Number of Military age (18—41) ..
(4) Number of Women ..

Total as above (c) at March 31st, 1917 ..

Analysis of (c) (3). (Men of Military Age (18—41)).

Number of Discharged Soldiers and Sailors
Number of Rejected Men
Number of Badged Men
Number of other grades

Total number of men of Military age as above (c) (3) ..

Names of undertakings to which the above returns apply :—

.....

.....

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CANADA.—The following reduced Customs duties are to be levied as from January 19th, in virtue of regulations made by Order in Council under Section 286 of the Customs Act, viz.—On battery jars of glass and articles of hard rubber when imported by manufacturers for use only in their own factories in the manufacture of electric storage batteries :—Under the British Preferential Tariff 12 per cent. *ad val.*, under the Intermediate Tariff 20 per cent. *ad val.*, and under the General Tariff 20 per cent. *ad val.*

* ELECTRICAL REVIEW, February 23rd, 1917, page 212.

UNITED KINGDOM AND CERTAIN FOREIGN COUNTRIES.—A Supplement (Part I) to the *Board of Trade Journal* of March 1st contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. This Supplement also contains the list of articles, complete to March 1st, which are prohibited to be exported from the United Kingdom. A further Supplement (Part II), issued on March 8th, contains similar lists for Norway, Portugal, Russia, Spain, Sweden, and Switzerland, and this Part contains also a copy of the United Kingdom Contraband List complete to date of publication. The information given in these two Supplements supersedes that given in the Supplements published on November 23rd and 30th last. Copies of the Supplements may be obtained, price 3d. each (post free 3½d.), from H.M. Stationery Office, Imperial House, Kingsway, W.C. 2.

SOUTH AFRICA.—In consequence of representations made to the High Commissioner for South Africa, the Union Government have extended to two months the time limit within which suppliers' invoices of goods shipped to South Africa must be dated previous to the date on which the vessel sails which carries the goods.

The High Commissioner for the Union draws attention to the provisions of Section 7 of Act 26 of 1914, and points out that the declaration of home consumption value must show prices current *at date of invoice*, and not that current when the order was accepted or contract entered into.

JOHORE.—A revised list of export duties came into operation on January 1st last. Wolfram and scheelite are free, but all other metals and metalliferous ores (except tin and gold) pay 10 per cent. *ad valorem*.

PERU.—A tax of 2 centavos on every kilogramme of rubber exported through the port of Iquitos is levied under a law dated October 11th last.

SEYCHELLES.—A recent Ordinance provides for the levy on all goods imported of a surtax not exceeding 10 per cent. on the amount of Customs duties now payable under Ordinance 3 of 1913, with the exception of wines and articles de mode. Under the existing Tariff the duty on all kinds of wire and on electrical apparatus is 12½ per cent. *ad valorem*, to which the above-mentioned surtax must now be added.

FRANCE AND ALGERIA.—The importation into France and Algeria of all goods produced in or coming from foreign countries is prohibited, by a Decree published on March 24th, with the exception of (a) goods imported on account of the State; (b) goods which are proved to have been dispatched direct to France or Algeria prior to March 24th; (c) goods declared for warehousing in those countries by the same date. Other exceptions may be allowed by the Minister of Finance, either of a general character, or within the limits of the contingents to be fixed by a new Committee ("Comité des derogations aux prohibitions d'entrée") which is to be set up in the Ministry of Commerce. In addition to fixing the quarterly contingents of imports for specified products, the Committee is to draw up and submit for approval proposals for general licences in respect of certain goods, and for each contingent a scheme for dividing the goods among the various industrial and commercial groups in proportion to their essential needs.

It is understood that the prohibition will not be brought into force until the contingents above referred to have been fixed.

SWITZERLAND.—A notification issued by the Swiss Customs Department provides that packing materials (sacks, wooden packing cases, glass receptacles, ropes and cords, &c.), which have been imported as containers of merchandise may be re-exported empty on production of documentary proof that the articles are in fact returned empties. [It should be remembered that an import licence will be necessary in the case of such returned packing materials as are covered by the British "Prohibition of Import" Proclamation.]

BRAZIL.—Among the requirements of the new Consular invoice regulations, laid down by the Brazilian Budget Law for 1917 (see the Electrical Review of April 6th), was one that packages entered on an invoice must be numbered consecutively. Cabled instructions have now been received by the Brazilian Consul General in London from the Ministry of Foreign Affairs suspending this requirement, but the re-requirements that each invoice must cover a shipment of goods bearing the same mark (thereby ensuring that the goods are destined for one consignee only) holds good. Shippers are also reminded that the old requirement that Bills of Lading and Consular Invoices should agree in every respect is still in force.

CANADA.—A recent Memorandum issued by the Department of Customs calls attention to the existing Regulation providing that the words "fair market value as sold for home consumption *at time shipped*" in the heading of one of the columns of the prescribed invoice form should be strictly adhered to. If importers desire to make an entry on invoice forms without this proper heading, but containing the usual certificate, entry may be accepted upon addition of 10 per cent. to invoice value pending delivery of proper invoices.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,720. "Automatic device for wireless signalling." J. Morrison & W. A. Morrison. April 2nd.
4,736. "Electrical instruments for transmission and/or reproduction of sound." D. F. McQuire & F. W. McQuire. April 2nd.
4,739. "Protective gear for dynamo-electric generators." H. Pearce. April 2nd.
4,758. "Telegraph systems." A. Davidson, J. A. L. Dearlove & N. J. Perryman. April 2nd.
4,773. "Magnetos." N. P. Rawlins. April 3rd.
4,808. "Manufacture of electric cables." C. J. Beaver & E. A. Claremont. April 3rd.
4,839. "Electric switches." C. C. Garrard & A. H. Railing. April 4th.
4,860. "Sparking plug." Bluemel Bros., and F. H. Bluemel & F. A. Saxelby. April 4th.
4,865. "Plug connections for electric circuits." H. Lucas & W. H. Edwards. April 4th.
4,866. "Electric arc lamps." H. B. Grylls & W. Heape. April 4th.
4,882. "Individual electric driving of machine tools, cranes, &c." H. Scholey. April 4th.
4,885. "Manufacture of plates for storage batteries." H. Wade (Flanders). April 4th.
4,886. "Manufacture of storage-battery plates, and paste therefor." H. Wade (Flanders). April 4th.
4,901. "Attachment for electric torches." J. F. Barr. April 5th.
4,923. "Electric welding device." F. B. Dehn (Electric Railway Improvement Co.). April 5th.
4,937. "Telephone appliance." F. Mayer. April 5th.
4,946. "Circuit interrupters." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). April 5th.
4,948. "Electric pocket lamps." S. Biheller. April 5th.
4,950. "Electrical instruments." H. A. Ewen & Marconi's Wireless Telegraph Co. April 5th.
4,957. "Electric interrupters for induction coils, &c." D. McLennan. April 5th.
4,963. "Electric switches." O. V. Forbes & J. Gell. April 5th.

PUBLISHED SPECIFICATIONS.

1915.

13,788. Dynamo-electric Machines. D. Suchostawer. (March 27th, 1916.) September 28th.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

6,869. Power Transmission Systems. W. Morrison. June 8th, 1915. (100,639.)
7,731. Starting Internal-combustion Engines. Bosch Magneto Co. June 12th, 1915. (100,682.)
9,588. Hauling or Winding Machinery. Siemens-Schuckertwerke Ges. September 4th, 1915. (101,407.)
146. Projection of a Light Beam. H. R. Evans. January 4th, 1916. (104,517.)
3,204. Automatic Night Tidal Semaphores and Tide Recorders. W. M. Greer (H. G. Reaks). March 3rd, 1916. (104,527.)
3,323. Incandescent-like Fire or Imitation Fire, or Luminous Body for Domestic Fireplaces, Stoves, Grates, or the like. C. O. Bastian & H. H. Berry. March 6th, 1916. (104,533.)
4,182. Methods of and Apparatus for Shaping Wire. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 21st, 1916. (104,561.)
7,376. Apparatus and Appliances for Preventing the Overwinding and Underwinding of Cranes, Hoists, Lifts, Winding Drums, and the like. E. Allen & Co. and E. H. Furnival. May 24th, 1916. (104,591.)
14,250. Sound Producing or Transmitting Apparatus. R. A. Fessenden. June 27th, 1916. (104,643.)
2,176. Electric Couplings. R. W. L. Phillips. February 14th, 1916. (104,702.)
3,637. Transformer and Oil Switch Vessels or Cooling Tanks or Oil Containers and the like, and the Method of Manufacturing the same. J. H. Davies. March 11th, 1916. (Cognate application, 11,647/16.) (104,717.)
3,657. Impulse Control Systems for Automatic Telephone Exchanges. Western Electric Co. & F. R. McBerty. March 11th, 1916. (Addition to 3,360/14.) (104,719.)
3,736. Semi-automatic Telephone Systems. Relay Automatic Telephone Co. & H. J. Herink. March 13th, 1916. (104,726.)
3,859. Dynamo-electric Machinery. J. H. St. H. Mawdsley & H. F. Joel. March 15th, 1916. (104,731.)
3,869. Stationary Contacts for Electric Switches or Circuit Breakers. F. B. Holt. March 15th, 1916. (104,733.)
3,896. Magneto-electric Machines for Ignition in Internal-combustion Engines. M. S. Conner & A. R. Kahl. March 16th, 1916. (104,736.)
4,006. Apparatus for Testing Electric Circuits. F. Proksch. March 22nd, 1915. (100,201.)
4,348. Arc Projector Lamps. J. Brockie and Johnson & Phillips. September 25th, 1916. (104,753.)
4,453. Electric Conductors Suitable for Sealing into Vitreous Material. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 25th, 1916. (104,758.)
4,532. Devices for Holding the Shades, Light Reflectors, or Diffusers for Lamps, such as Electric Incandescence Lamps. J. B. Mitchell, A. B. Shaw & W. Taylor. March 27th, 1916. March 27th, 1916. (104,759.)
4,639. Apparatus for Adjusting the Ignition in Internal-combustion Engines. E. Marazzi. March 29th, 1916. (104,762.)
4,865. Sparking Plugs for use on Internal-combustion Engines. J. J. Creasey. April 3rd, 1916. (104,770.)
4,941. Automatic Voltage Regulators as Applied to Internal-combustion Engines Driving Motor Vehicles. P. F. Smith & V. S. Robinson. April 4th, 1916. (104,772.)
5,464. Electric Signalling or Telegraphing Systems. T. McLeod. April 13th, 1916. (Cognate applications, 7,156/16, and 9,750/16.) (104,777.)
7,328. Multicore Electric Cables. J. O. Callender and Callender's Cable & Construction Co. May 23rd, 1916. (104,793.)
8,831. Electrically-welded Wire Fabric or the like. British Reinforced Concrete Engineering Co. & E. B. Hall. June 23rd, 1916. (104,807.)
9,137. Sparking Plugs for Internal-combustion Engines. F. A. L. Johnson. June 29th, 1916. (104,808.)
10,361. Means of Control for Petrol Electric Vehicles. Tilling-Stevens, Ltd., & P. F. Smith. July 22nd, 1916. (104,819.)
12,410. Means for the Control Electrically of the Signal Indicators used in connection with Mine Hauling Engines, Winding Engines, and the like. J. P. Forster. September 1st, 1916. (104,828.)
12,420. Arrangement of Regulator and Circuit Interrupter fixed upon Electric Generators having a Variable Speed. Soc. Anon. pour l'Eclairage Electrique des Vehicules. November 29th, 1916. (102,483.)
17,074. Electric Battery Lamp. J. E. Hamilton. July 25th, 1916. (Divided application on 3,029/16.) (104,847.)